1 Practice Questions - CSC262 - FALL 2015

1.1 One Sample Procedures for Population Means and Variances

Q1: For an *iid* sample from a normal distribution we are given sample mean $\bar{X}$ = 10.044, $n = 12$, standard deviation $\sigma = 1$. Calculate a confidence interval for population mean μ with confidence level $1 - \alpha = 0.95$.

Q2: For an *iid* sample from a normal distribution we are given sample mean $\bar{X}$ = -2.71, $n = 100$, standard deviation $\sigma = 6$. Calculate a confidence interval for population mean μ with confidence level $1 - \alpha = 0.95$.

Q3: For an *iid* sample from a normal distribution we are given sample mean $\bar{X}$ = 13.379, $n = 56$, standard deviation $\sigma = 2.5$. Calculate a confidence interval for population mean μ with confidence level $1 - \alpha = 0.9$.

Q4: For an *iid* sample from a normal distribution we are given sample mean $\bar{X}$ = 34.862, $n = 100$, standard deviation $\sigma = 13$. Calculate a confidence interval for population mean μ with confidence level $1 - \alpha = 0.99$.

Q5: For an *iid* sample from a normal distribution we are given sample standard deviation $S = 0.00213$, with sample size $n = 100$. Calculate a confidence interval for population standard deviation σ, using confidence level $1 - \alpha = 0.95$. Also give the level $1 - \alpha = 0.95$ lower and upper confidence bounds.

Q6: For an *iid* sample from a normal distribution we are given sample standard deviation $S = 2.606$, with sample size $n = 6$. Calculate a confidence interval for population standard deviation σ, using confidence level $1 - \alpha = 0.99$. Also give the level $1 - \alpha = 0.99$ lower and upper confidence bounds.

Q7: For an *iid* sample from a normal distribution we are given sample standard deviation $S = 304.129$, with sample size $n = 25$. Calculate a confidence interval for population standard deviation σ, using confidence level $1 - \alpha = 0.95$. Also give the level $1 - \alpha = 0.95$ lower and upper confidence bounds.

Q8: For an *iid* sample from a normal distribution we are given sample standard deviation $S = 11.656$, with sample size $n = 369$. Calculate a confidence interval for population standard deviation σ, using confidence level $1 - \alpha = 0.9$. Also give the level $1 - \alpha = 0.9$ lower and upper confidence bounds.

Q9: For an *iid* sample from a normal distribution we are given sample mean $\bar{X}$ = 183.725, $n = 20$, standard deviation $\sigma = 18.26$. Perfom a two-sided hypothesis test using hypotheses $H_o : \mu = 170.87$ against $H_a : \mu \neq 170.87$. Use significance level $\alpha = 0.05$.

Q10: For an *iid* sample from a normal distribution we are given sample mean $\bar{X}$ = 146.648, $n = 19$, sample standard deviation $S = 15.49$. Perfom a two-sided hypothesis test using hypotheses $H_o : \mu = 135.591$ against $H_a : \mu \neq 135.591$. Use significance level $\alpha = 0.05$.

Q11: For an *iid* sample from a normal distribution we are given sample mean $\bar{X}$ = 131.051, $n = 86$, standard deviation $\sigma = 13.15$. Perfom a two-sided hypothesis test using hypotheses $H_o : \mu = 121.143$ against $H_a : \mu \neq 121.143$. Use significance level α = 0.05.

Q12: For an iid sample from a normal distribution we are given sample mean $\bar{X}$ = 540.481, n = 73, sample standard deviation S = 52.033. Perfom an upper tailed hypothesis test using hypotheses $H_o : \mu = 541.39$ against $H_a : \mu > 541.39$. Use significance level $\alpha = 0.01$.

Q13: For an iid sample from a normal distribution we are given sample mean $\bar{X}$ = 5.615, n = 99, sample standard deviation S = 0.551. Perfom an upper tailed hypothesis test using hypotheses $H_o : \mu = 5.438$ against $H_a : \mu > 5.438$. Use significance level α = 0.1.

Q14: For an iid sample from a normal distribution we are given sample mean $\bar{X}$ = 41.446, n = 57, sample standard deviation S = 4.377. Perfom an upper tailed hypothesis test using hypotheses $H_o : \mu = 39.787$ against $H_a : \mu > 39.787$. Use significance level $\alpha = 0.05$.

Q15: For an iid sample from a normal distribution we are given sample mean $\bar{X}$ = 104.364, n = 99, sample standard deviation S = 10.136. Perfom a two-sided hypothesis test using hypotheses $H_o : \mu = 103$ against $H_a : \mu \neq 103$. Use significance level α = 0.05.

Q16: For an iid sample from a normal distribution we are given sample mean $\bar{X}$ = 52.864, n = 23, sample standard deviation S = 5.607. Perfom a two-sided hypothesis test using hypotheses $H_o : \mu = 49.089$ against $H_a : \mu \neq 49.089$. Use significance level $\alpha = 0.05$.

Q17: For an iid sample from a normal distribution we are given sample mean $\bar{X}$ = 70.078, n = 70, sample standard deviation S = 7.283. Perfom a two-sided hypothesis test using hypotheses $H_o : \mu = 63.606$ against $H_a : \mu \neq 63.606$. Use significance level $\alpha = 0.01$.

Q18: For an iid sample from a normal distribution we are given sample mean $\bar{X}$ = 93.144, n = 74, standard deviation σ = 9.34. Perfom an upper tailed hypothesis test using hypotheses $H_o : \mu = 88.163$ against $H_a : \mu > 88.163$. Use significance level α = 0.1.

Q19: For an iid sample from a normal distribution we are given sample mean $\bar{X}$ = 74.663, n = 56, sample standard deviation S = 7.798. Perfom an upper tailed hypothesis test using hypotheses $H_o : \mu = 70.931$ against $H_a : \mu > 70.931$. Use significance level $\alpha = 0.05$.

Q20: For an iid sample from a normal distribution we are given sample mean $\bar{X}$ = 70.24, n = 11, sample standard deviation S = 6.882. Perfom an upper tailed hypothesis test using hypotheses $H_o : \mu = 67.034$ against $H_a : \mu > 67.034$. Use significance level $\alpha = 0.05$.

Q21: For an iid sample from a normal distribution we are given sample mean $\bar{X}$ = 348.626, n = 88, standard deviation σ = 35.95. Perfom a two-sided hypothesis test using hypotheses $H_o : \mu = 331.185$ against $H_a : \mu \neq 331.185$. Use significance level α = 0.05.

Q22: For an iid sample from a normal distribution we are given sample mean $\bar{X}$ = 11.311, n = 55, sample standard deviation S = 1.162. Perfom an upper tailed hypothesis test using hypotheses $H_o : \mu = 11.271$ against $H_a : \mu > 11.271$. Use significance level

$\alpha = 0.01$.

Q23: For an *iid* sample from a normal distribution we are given sample mean $\bar{X} = 1.811$, $n = 97$, sample standard deviation $S = 0.172$. Perfom an upper tailed hypothesis test using hypotheses $H_o : \mu = 1.78$ against $H_a : \mu > 1.78$. Use significance level $\alpha = 0.1$.

Q24: For an *iid* sample from a normal distribution we are given sample mean $\bar{X} = 14.29$, $n = 64$, standard deviation $\sigma = 1.44$. Perfom an upper tailed hypothesis test using hypotheses $H_o : \mu = 13.974$ against $H_a : \mu > 13.974$. Use significance level $\alpha = 0.05$.

Q25: For an *iid* sample from a normal distribution we are given sample mean $\bar{X} = 28.954$, $n = 91$, standard deviation $\sigma = 2.9$. Perfom an upper tailed hypothesis test using hypotheses $H_o : \mu = 28.944$ against $H_a : \mu > 28.944$. Use significance level $\alpha = 0.05$.

Q26: For an *iid* sample from a normal distribution we are given sample mean $\bar{X} = 79.857$, $n = 27$, standard deviation $\sigma = 7.84$. Perfom a two-sided hypothesis test using hypotheses $H_o : \mu = 72.342$ against $H_a : \mu \neq 72.342$. Use significance level $\alpha = 0.05$.

Q27: For an *iid* sample from a normal distribution we are given sample mean $\bar{X} = 16.226$, $n = 33$, standard deviation $\sigma = 1.6$. Perfom a two-sided hypothesis test using hypotheses $H_o : \mu = 14.685$ against $H_a : \mu \neq 14.685$. Use significance level $\alpha = 0.01$.

Q28: For an *iid* sample from a normal distribution we are given sample mean $\bar{X} = 248.319$, $n = 7$, standard deviation $\sigma = 24.76$. Perfom an upper tailed hypothesis test using hypotheses $H_o : \mu = 233.717$ against $H_a : \mu > 233.717$. Use significance level $\alpha = 0.1$.

1.2 Two Sample Procedures for Population Means and Variances

Q29: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Calculate a confidence interval for $\mu_1 - \mu_2$ with confidence level $1 - \alpha = 0.95$.

	Sample 1	Sample 2
$\bar{X}$	27.7910	28.0390
σ	1.4600	1.8200
n	23.0000	91.0000

Q30: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Calculate a confidence interval for $\mu_1 - \mu_2$ with confidence level $1 - \alpha = 0.95$.

	Sample 1	Sample 2
$\bar{X}$	46.3710	45.6730
σ	1.2000	1.4900
n	13.0000	71.0000

Q31: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Use an F-test to test for equality of variances, using significance level $\alpha = 0.05$. Using the appropriate procedure based on the test for equality of variances, calculate a confidence interval for $\mu_1 - \mu_2$ with confidence level $1 - \alpha = 0.95$.

	Sample 1	Sample 2
$\bar{X}$	104.8150	104.4920
S	0.4980	0.5170
n	31.0000	60.0000

Q32: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Use an F-test to test for equality of variances, using significance level $\alpha = 0.05$. Using the appropriate procedure based on the test for equality of variances, calculate a confidence interval for $\mu_1 - \mu_2$ with confidence level $1 - \alpha = 0.9$.

	Sample 1	Sample 2
$\bar{X}$	138.5500	138.9710
S	0.6290	0.4930
n	83.0000	41.0000

Q33: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Calculate a confidence interval for $\mu_1 - \mu_2$ with confidence level $1 - \alpha = 0.99$.

	Sample 1	Sample 2
$\bar{X}$	6.0870	5.8550
σ	2.0000	2.0000
n	99.0000	12.0000

Q34: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Use an F-test to test for equality of variances, using significance level $\alpha = 0.05$. Using the appropriate procedure based on the test for equality of variances, calculate a confidence interval for $\mu_1 - \mu_2$ with confidence level $1 - \alpha = 0.95$.

	Sample 1	Sample 2
$\bar{X}$	56.5000	56.6030
S	0.7770	0.5550
n	9.0000	26.0000

Q35: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Use an F-test to test for equality of variances, using significance level $\alpha = 0.05$. Using the appropriate procedure based on the test for equality of variances, calculate a confidence interval for $\mu_1 - \mu_2$ with confidence level $1 - \alpha = 0.95$.

	Sample 1	Sample 2
$\bar{X}$	200.8610	201.0480
S	0.4600	0.4370
n	92.0000	83.0000

Q36: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Calculate a confidence interval for $\mu_1 - \mu_2$ with confidence level $1 - \alpha = 0.95$.

	Sample 1	Sample 2
$\bar{X}$	181.2900	181.2080
σ	0.3500	0.4400
n	84.0000	101.0000

Q37: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Use an F-test to test for equality of variances, using significance level $\alpha = 0.05$. Using the appropriate procedure based on the test for equality of variances, calculate a confidence interval for $\mu_1 - \mu_2$ with confidence level $1 - \alpha = 0.9$.

	Sample 1	Sample 2
$\bar{X}$	203.8920	204.1450
S	0.6830	0.4900
n	15.0000	38.0000

Q38: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Use an F-test to test for equality of variances, using significance level $\alpha = 0.05$. Using the appropriate procedure based on the test for equality of variances, calculate a confidence interval for $\mu_1 - \mu_2$ with confidence level $1 - \alpha = 0.99$.

	Sample 1	Sample 2
$\bar{X}$	128.1020	127.8600
S	1.8410	1.1910
n	101.0000	71.0000

Q39: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Calculate a confidence interval for $\mu_1 - \mu_2$ with confidence level $1 - \alpha = 0.95$.

	Sample 1	Sample 2
$\bar{X}$	502.7110	501.6330
σ	0.9300	0.9300
n	78.0000	79.0000

Q40: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Use an F-test to test for equality of variances, using significance level $\alpha = 0.05$. Using the appropriate procedure based on the test for equality of variances, calculate a confidence interval for $\mu_1 - \mu_2$ with confidence level $1 - \alpha = 0.95$.

	Sample 1	Sample 2
$\bar{X}$	71.3290	69.6590
S	1.2550	1.8390
n	74.0000	10.0000

Q41: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Calculate a confidence interval for $\mu_1 - \mu_2$ with confidence level $1 - \alpha = 0.95$.

	Sample 1	Sample 2
$\bar{X}$	40.5250	40.5010
σ	0.4700	0.3600
n	28.0000	10.0000

Q42: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Use an F-test to test for equality of variances, using significance level $\alpha = 0.05$. Using the appropriate procedure based on the test for equality of variances, calculate a confidence interval for $\mu_1 - \mu_2$ with confidence level $1 - \alpha = 0.9$.

	Sample 1	Sample 2
$\bar{X}$	79.2220	79.4440
S	0.2200	0.2570
n	94.0000	34.0000

Q43: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Calculate a confidence interval for $\mu_1 - \mu_2$ with confidence level $1 - \alpha = 0.99$.

	Sample 1	Sample 2
$\bar{X}$	24.5660	24.0990
σ	0.9000	0.6800
n	49.0000	94.0000

Q44: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Use an F-test to test for equality of variances, using significance level $\alpha = 0.05$. Using the appropriate procedure based on the test for equality of variances, calculate a confidence interval for $\mu_1 - \mu_2$ with confidence level $1 - \alpha = 0.95$.

	Sample 1	Sample 2
$\bar{X}$	136.3390	136.7330
S	0.5980	0.7340
n	101.0000	21.0000

Q45: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Calculate a confidence interval for $\mu_1 - \mu_2$ with confidence level $1 - \alpha = 0.95$.

	Sample 1	Sample 2
$\bar{X}$	31.2130	31.8500
σ	0.8200	0.6200
n	100.0000	63.0000

Q46: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Calculate a confidence interval for $\mu_1 - \mu_2$ with confidence level $1 - \alpha = 0.95$.

	Sample 1	Sample 2
$\bar{X}$	92.5550	91.5090
σ	3.1200	3.9000
n	16.0000	73.0000

Q47: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Use an F-test to test for equality of variances, using significance level $\alpha = 0.05$. Using the appropriate procedure based on the test for equality of variances, calculate a confidence interval for $\mu_1 - \mu_2$ with confidence level $1 - \alpha = 0.9$.

	Sample 1	Sample 2
$\bar{X}$	100.9390	101.3000
S	0.6360	0.8820
n	22.0000	90.0000

Q48: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Calculate a confidence interval for $\mu_1 - \mu_2$ with confidence level $1 - \alpha = 0.99$.

	Sample 1	Sample 2
$\bar{X}$	90.8410	91.1910
σ	0.7500	0.9400
n	73.0000	46.0000

Q49: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Perfom a lower tailed hypothesis test using hypotheses $H_o: \mu_1 - \mu_2 = 0$ against $H_a: \mu_1 - \mu_2 < 0$. Use significance level $\alpha = 0.05$.

	Sample 1	Sample 2
$\bar{X}$	104.3600	107.3850
σ	5.4400	2.7200
n	43.0000	68.0000

Q50: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Perform an upper tailed hypothesis test using hypotheses $H_o: \mu_1 - \mu_2 = 0$ against $H_a: \mu_1 - \mu_2 > 0$. Use significance level $\alpha = 0.01$.

	Sample 1	Sample 2
$\bar{X}$	66.8030	66.7900
S	0.0810	0.0848
n	98.0000	13.0000

Q51: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Perfom a lower tailed hypothesis test using hypotheses $H_o: \mu_1 - \mu_2 = 0$ against $H_a: \mu_1 - \mu_2 < 0$. Use significance level $\alpha = 0.05$.

	Sample 1	Sample 2
$\bar{X}$	10.9070	11.4860
S	0.6220	0.8140
n	86.0000	45.0000

Q52: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Perfom a two-sided hypothesis test using hypotheses $H_o: \mu_1 - \mu_2 = 0$ against $H_a: \mu_1 - \mu_2 \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1	Sample 2
$\bar{X}$	1.7570	3.3980
σ	4.1600	4.1600
n	80.0000	45.0000

Q53: We are given two independent samples from normally distributed populations.

The data is summarized in the table below. Perform a two-sided hypothesis test using hypotheses $H_o : \mu_1 - \mu_2 = 0$ against $H_a : \mu_1 - \mu_2 \neq 0$. Use significance level $\alpha = 0.1$.

	Sample 1	Sample 2
$\bar{X}$	10.3000	10.3200
S	0.1380	0.1330
n	71.0000	96.0000

Q54: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Perfom a two-sided hypothesis test using hypotheses $H_o : \mu_1 - \mu_2 = 0$ against $H_a : \mu_1 - \mu_2 \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1	Sample 2
$\bar{X}$	0.0714	-0.6410
σ	1.2200	0.9200
n	82.0000	93.0000

Q55: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Perfom a two-sided hypothesis test using hypotheses $H_o : \mu_1 - \mu_2 = 0$ against $H_a : \mu_1 - \mu_2 \neq 0$. Use significance level $\alpha = 0.01$.

	Sample 1	Sample 2
$\bar{X}$	45.6540	46.0540
σ	2.6900	1.3500
n	81.0000	103.0000

Q56: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Perfom a lower tailed hypothesis test using hypotheses $H_o : \mu_1 - \mu_2 = 0$ against $H_a : \mu_1 - \mu_2 < 0$. Use significance level $\alpha = 0.05$.

	Sample 1	Sample 2
$\bar{X}$	59.5240	58.1920
S	1.2840	1.8900
n	69.0000	9.0000

Q57: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Perform a two-sided hypothesis test using hypotheses $H_o : \mu_1 - \mu_2 = 0$ against $H_a : \mu_1 - \mu_2 \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1	Sample 2
$\bar{X}$	21.9220	22.3830
S	0.7450	0.8920
n	44.0000	93.0000

Q58: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Perfom an upper tailed hypothesis test using hypotheses $H_o : \mu_1 - \mu_2 = 0$ against $H_a : \mu_1 - \mu_2 > 0$. Use significance level $\alpha = 0.1$.

	Sample 1	Sample 2
$\bar{X}$	13.8210	13.3190
σ	0.8300	1.2500
n	77.0000	87.0000

Q59: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Perform a two-sided hypothesis test using hypotheses $H_o : \mu_1 - \mu_2 = 0$ against $H_a : \mu_1 - \mu_2 \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1	Sample 2
$\bar{X}$	21.5530	21.7480
S	1.2590	1.2370
n	66.0000	33.0000

Q60: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Perfom a two-sided hypothesis test using hypotheses $H_o : \mu_1 - \mu_2 = 0$ against $H_a : \mu_1 - \mu_2 \neq 0$. Use significance level $\alpha = 0.01$.

	Sample 1	Sample 2
$\bar{X}$	14.9650	16.7930
σ	4.7500	1.1900
n	78.0000	61.0000

Q61: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Perform a two-sided hypothesis test using hypotheses $H_o : \mu_1 - \mu_2 = 0$ against $H_a : \mu_1 - \mu_2 \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1	Sample 2
$\bar{X}$	17.8990	18.7410
S	2.2590	1.6980
n	96.0000	81.0000

Q62: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Perform an upper tailed hypothesis test using hypotheses $H_o : \mu_1 - \mu_2 = 0$ against $H_a : \mu_1 - \mu_2 > 0$. Use significance level $\alpha = 0.05$.

	Sample 1	Sample 2
$\bar{X}$	4.8280	3.0180
S	1.4710	2.2320
n	62.0000	81.0000

Q63: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Perform an upper tailed hypothesis test using hypotheses $H_o: \mu_1 - \mu_2 = 0$ against $H_a: \mu_1 - \mu_2 > 0$. Use significance level $\alpha = 0.1$.

	Sample 1	Sample 2
$\bar{X}$	20.5670	19.8940
S	1.7560	2.0290
n	31.0000	53.0000

Q64: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Perfom a two-sided hypothesis test using hypotheses $H_o: \mu_1 - \mu_2 = 0$ against $H_a: \mu_1 - \mu_2 \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1	Sample 2
$\bar{X}$	4.8630	4.6870
σ	0.7000	0.7000
n	68.0000	9.0000

Q65: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Perform a two-sided hypothesis test using hypotheses $H_o: \mu_1 - \mu_2 = 0$ against $H_a: \mu_1 - \mu_2 \neq 0$. Use significance level $\alpha = 0.01$.

	Sample 1	Sample 2
$\bar{X}$	72.9380	71.5150
S	1.6880	2.5170
n	87.0000	67.0000

Q66: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Perfom an upper tailed hypothesis test using hypotheses $H_o: \mu_1 - \mu_2 = 0$ against $H_a: \mu_1 - \mu_2 > 0$. Use significance level $\alpha = 0.05$.

	Sample 1	Sample 2
$\bar{X}$	6.6230	6.4920
σ	3.2700	2.4500
n	46.0000	75.0000

Q67: We are given two independent samples from normally distributed populations.

The data is summarized in the table below. Perfom a two-sided hypothesis test using hypotheses $H_o: \mu_1 - \mu_2 = 0$ against $H_a: \mu_1 - \mu_2 \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1	Sample 2
$\bar{X}$	27.0030	26.3960
σ	2.4100	2.4100
n	61.0000	90.0000

Q68: We are given two independent samples from normally distributed populations. The data is summarized in the table below. Perfom a two-sided hypothesis test using hypotheses $H_o: \mu_1 - \mu_2 = 0$ against $H_a: \mu_1 - \mu_2 \neq 0$. Use significance level $\alpha = 0.1$.

	Sample 1	Sample 2
$\bar{X}$	15.8620	15.5870
σ	0.9300	1.1600
n	89.0000	69.0000

Q69: We are given two paired samples from normally distributed populations ($n = 8$). The data is summarized in the table below. Perform a two-sided hypothesis test using hypotheses $H_o: \mu_1 - \mu_2 = 0$ against $H_a: \mu_1 - \mu_2 \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1	Sample 2	Difference
1	-1.2100	1.0000	-2.2100
2	-0.4760	2.1980	-2.6740
3	-0.0141	2.8070	-2.8211
4	0.6100	2.1590	-1.5490
5	0.0710	2.9740	-2.9030
6	0.6130	3.4130	-2.8000
7	-0.7490	0.9570	-1.7060
8	0.5550	2.8090	-2.2540

Q70: We are given two paired samples from normally distributed populations ($n = 10$). The data is summarized in the table below. Perform a two-sided hypothesis test using hypotheses $H_o: \mu_1 - \mu_2 = 0$ against $H_a: \mu_1 - \mu_2 \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1	Sample 2	Difference
1	18.8990	14.0270	4.8720
2	18.5750	14.0780	4.4970
3	20.0910	16.4450	3.6460
4	21.3960	17.4230	3.9730
5	19.5810	15.3600	4.2210
6	17.5550	12.9370	4.6180
7	18.4640	14.3990	4.0650
8	18.3150	14.0820	4.2330
9	18.1770	14.3310	3.8460
10	18.0650	13.5350	4.5300

Q71: We are given two paired samples from normally distributed populations ($n = 5$). The data is summarized in the table below. Perform a two-sided hypothesis test using hypotheses $H_o : \mu_1 - \mu_2 = 0$ against $H_a : \mu_1 - \mu_2 \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1	Sample 2	Difference
1	3.9950	2.8140	1.1810
2	-3.1700	-0.5930	-2.5770
3	0.1560	0.0557	0.1003
4	-1.3900	-2.4000	1.0100
5	2.6130	4.8640	-2.2510

Q72: We are given two paired samples from normally distributed populations ($n = 8$). The data is summarized in the table below. Perform a two-sided hypothesis test using hypotheses $H_o : \mu_1 - \mu_2 = 0$ against $H_a : \mu_1 - \mu_2 \neq 0$. Use significance level $\alpha = 0.01$.

	Sample 1	Sample 2	Difference
1	21.8290	28.0710	-6.2420
2	20.0770	25.6310	-5.5540
3	20.6220	29.8470	-9.2250
4	21.6720	29.0700	-7.3980
5	19.8880	28.4990	-8.6110
6	20.2120	23.4080	-3.1960
7	20.7780	25.2720	-4.4940
8	22.9900	28.9630	-5.9730

Q73: We are given two paired samples from normally distributed populations ($n = 8$). The data is summarized in the table below. Perform a two-sided hypothesis test using hypotheses $H_o : \mu_1 - \mu_2 = 0$ against $H_a : \mu_1 - \mu_2 \neq 0$. Use significance level $\alpha = 0.1$.

	Sample 1	Sample 2	Difference
1	6.3450	6.5790	-0.2340
2	5.1620	6.0120	-0.8500
3	5.6210	5.7620	-0.1410
4	5.5820	6.1880	-0.6060
5	6.0610	6.0150	0.0460
6	6.0060	6.1580	-0.1520
7	5.7190	6.4530	-0.7340
8	6.5130	6.8840	-0.3710

Q74: We are given two paired samples from normally distributed populations ($n = 7$). The data is summarized in the table below. Perform a two-sided hypothesis test using hypotheses $H_o : \mu_1 - \mu_2 = 0$ against $H_a : \mu_1 - \mu_2 \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1	Sample 2	Difference
1	12.2070	12.6860	-0.4790
2	12.1580	11.6300	0.5280
3	13.0560	12.6710	0.3850
4	12.0350	11.5390	0.4960
5	12.3420	11.6520	0.6900
6	11.6160	11.7240	-0.1080
7	13.1690	14.7780	-1.6090

Q75: We are given two paired samples from normally distributed populations ($n = 5$). The data is summarized in the table below. Perform a two-sided hypothesis test using hypotheses $H_o : \mu_1 - \mu_2 = 0$ against $H_a : \mu_1 - \mu_2 \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1	Sample 2	Difference
1	-0.2440	-0.9630	0.7190
2	0.9480	1.1660	-0.2180
3	0.1120	-2.4800	2.5920
4	-1.3000	-1.6600	0.3600
5	0.2650	-1.1500	1.4150

Q76: We are given two paired samples from normally distributed populations ($n = 10$). The data is summarized in the table below. Perform a two-sided hypothesis test using hypotheses $H_o : \mu_1 - \mu_2 = 0$ against $H_a : \mu_1 - \mu_2 \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1	Sample 2	Difference
1	8.6160	4.8270	3.7890
2	14.6440	11.6690	2.9750
3	10.3560	5.3770	4.9790
4	8.9910	5.1300	3.8610
5	10.4610	9.4580	1.0030
6	12.8990	10.0870	2.8120
7	13.3900	7.8980	5.4920
8	10.5550	10.9540	-0.3990
9	10.2870	4.5870	5.7000
10	11.6360	9.3650	2.2710

Q77: We are given two paired samples from normally distributed populations ($n = 7$). The data is summarized in the table below. Perform a two-sided hypothesis test using hypotheses $H_o : \mu_1 - \mu_2 = 0$ against $H_a : \mu_1 - \mu_2 \neq 0$. Use significance level $\alpha = 0.01$.

	Sample 1	Sample 2	Difference
1	6.8720	7.0100	-0.1380
2	6.8980	7.3930	-0.4950
3	7.4540	7.8560	-0.4020
4	7.2190	6.6050	0.6140
5	6.9530	6.5210	0.4320
6	6.9870	6.5220	0.4650
7	7.0400	6.9950	0.0450

Q78: We are given two paired samples from normally distributed populations ($n = 5$). The data is summarized in the table below. Perform a two-sided hypothesis test using hypotheses $H_o : \mu_1 - \mu_2 = 0$ against $H_a : \mu_1 - \mu_2 \neq 0$. Use significance level $\alpha = 0.1$.

	Sample 1	Sample 2	Difference
1	4.3670	4.7150	-0.3480
2	5.5810	6.4860	-0.9050
3	6.3210	7.3940	-1.0730
4	6.1750	6.4860	-0.3110
5	5.6770	6.7130	-1.0360

1.3 One Sample Procedures for Population Proportions

Q79: Given an *iid* sample of size $n = 80$ we observe a count of $X = 31$ of a certain category. Suppose p is the population proportion of that category. Calculate a confidence interval for p with confidence level $1 - \alpha = 0.95$.

Q80: Given an iid sample of size $n = 385$ we observe a count of $X = 137$ of a certain category. Suppose p is the population proportion of that category. Calculate a confidence interval for p with confidence level $1 - \alpha = 0.95$.

Q81: Given an iid sample of size $n = 292$ we observe a count of $X = 141$ of a certain category. Suppose p is the population proportion of that category. Calculate a confidence interval for p with confidence level $1 - \alpha = 0.95$.

Q82: Given an iid sample of size $n = 56$ we observe a count of $X = 18$ of a certain category. Suppose p is the population proportion of that category. Calculate a confidence interval for p with confidence level $1 - \alpha = 0.9$.

Q83: Given an iid sample of size $n = 337$ we observe a count of $X = 81$ of a certain category. Suppose p is the population proportion of that category. Calculate a confidence interval for p with confidence level $1 - \alpha = 0.99$.

Q84: Given an iid sample of size $n = 409$ we observe a count of $X = 119$ of a certain category. Suppose p is the population proportion of that category. Calculate a confidence interval for p with confidence level $1 - \alpha = 0.95$.

Q85: Given an iid sample of size $n = 44$ we observe a count of $X = 31$ of a certain category. Suppose p is the population proportion of that category. Calculate a confidence interval for p with confidence level $1 - \alpha = 0.95$.

Q86: Given an iid sample of size $n = 55$ we observe a count of $X = 18$ of a certain category. Suppose p is the population proportion of that category. Calculate a confidence interval for p with confidence level $1 - \alpha = 0.95$.

Q87: Given an iid sample of size $n = 118$ we observe a count of $X = 29$ of a certain category. Suppose p is the population proportion of that category. Calculate a confidence interval for p with confidence level $1 - \alpha = 0.9$.

Q88: Given an iid sample of size $n = 17$ we observe a count of $X = 3$ of a certain category. Suppose p is the population proportion of that category. Calculate a confidence interval for p with confidence level $1 - \alpha = 0.99$.

Q89: We wish to investigate a population proportion p of a given type, using a sample of size $n = 185$. Suppose we observe a type count of $X = 73$. Perfom a two-sided hypothesis test using hypotheses $H_o : p = 0.553$ against $H_a : p \neq 0.553$. Use significance level $\alpha = 0.05$.

Q90: We wish to investigate a population proportion p of a given type, using a sample of size $n = 339$. Suppose we observe a type count of $X = 107$. Perfom a two-sided hypothesis test using hypotheses $H_o : p = 0.408$ against $H_a : p \neq 0.408$. Use significance level $\alpha = 0.05$.

Q91: We wish to investigate a population proportion p of a given type, using a sample of size $n = 308$. Suppose we observe a type count of $X = 132$. Perfom a two-sided hypothesis test using hypotheses $H_o : p = 0.359$ against $H_a : p \neq 0.359$. Use significance level $\alpha = 0.05$.

Q92: We wish to investigate a population proportion p of a given type, using a sample of size $n = 221$. Suppose we observe a type count of $X = 85$. Perfom a two-sided hypothesis test using hypotheses $H_o : p = 0.578$ against $H_a : p \neq 0.578$. Use significance level $\alpha = 0.01$.

Q93: We wish to investigate a population proportion p of a given type, using a sample of size $n = 220$. Suppose we observe a type count of $X = 86$. Perfom a two-sided hypothesis test using hypotheses $H_o : p = 0.332$ against $H_a : p \neq 0.332$. Use significance level $\alpha = 0.1$.

Q94: We wish to investigate a population proportion p of a given type, using a sample of size $n = 391$. Suppose we observe a type count of $X = 178$. Perfom a two-sided hypothesis test using hypotheses $H_o : p = 0.42$ against $H_a : p \neq 0.42$. Use significance level $\alpha = 0.05$.

Q95: We wish to investigate a population proportion p of a given type, using a sample of size $n = 299$. Suppose we observe a type count of $X = 200$. Perfom a two-sided hypothesis test using hypotheses $H_o : p = 0.83$ against $H_a : p \neq 0.83$. Use significance level $\alpha = 0.05$.

Q96: We wish to investigate a population proportion p of a given type, using a sample of size $n = 310$. Suppose we observe a type count of $X = 95$. Perfom a two-sided hypothesis test using hypotheses $H_o : p = 0.239$ against $H_a : p \neq 0.239$. Use significance level $\alpha = 0.05$.

Q97: We wish to investigate a population proportion p of a given type, using a sample of size $n = 390$. Suppose we observe a type count of $X = 119$. Perfom a two-sided hypothesis test using hypotheses $H_o : p = 0.282$ against $H_a : p \neq 0.282$. Use significance level $\alpha = 0.01$.

Q98: We wish to investigate a population proportion p of a given type, using a sample of size $n = 188$. Suppose we observe a type count of $X = 115$. Perfom a two-sided hypothesis test using hypotheses $H_o : p = 0.722$ against $H_a : p \neq 0.722$. Use significance level $\alpha = 0.1$.

1.4 Two Sample Procedures for Population Proportions

Q99: Categorical counts from two independent samples are summarized in the following table, along with the sample sizes n. Suppose p_1 and p_2 are the respective population proportions of the category. Calculate a confidence interval for $p_1 - p_2$ with confidence level $1 - \alpha = 0.95$.

	Sample 1	Sample 2
X	176.0000	176.0000
n	263.0000	226.0000
$\hat{p}$	0.6690	0.7790

Q100: Categorical counts from two independent samples are summarized in the following table, along with the sample sizes n. Suppose p_1 and p_2 are the respective population proportions of the category. Calculate a confidence interval for $p_1 - p_2$ with confidence level $1 - \alpha = 0.95$.

	Sample 1	Sample 2
X	120.0000	236.0000
n	245.0000	456.0000
$\hat{p}$	0.4900	0.5180

Q101: Categorical counts from two independent samples are summarized in the following table, along with the sample sizes n. Suppose p_1 and p_2 are the respective population proportions of the category. Calculate a confidence interval for $p_1 - p_2$ with confidence level $1 - \alpha = 0.95$.

	Sample 1	Sample 2
X	20.0000	232.0000
n	33.0000	291.0000
$\hat{p}$	0.6060	0.7970

Q102: Categorical counts from two independent samples are summarized in the following table, along with the sample sizes n. Suppose p_1 and p_2 are the respective population proportions of the category. Calculate a confidence interval for $p_1 - p_2$ with confidence level $1 - \alpha = 0.99$.

	Sample 1	Sample 2
X	4.0000	116.0000
n	6.0000	151.0000
$\hat{p}$	0.6670	0.7680

Q103: Categorical counts from two independent samples are summarized in the following table, along with the sample sizes n. Suppose p_1 and p_2 are the respective population proportions of the category. Calculate a confidence interval for $p_1 - p_2$ with confidence level $1 - \alpha = 0.9$.

	Sample 1	Sample 2
X	128.0000	323.0000
n	192.0000	379.0000
$\hat{p}$	0.6670	0.8520

Q104: Categorical counts from two independent samples are summarized in the following table, along with the sample sizes n. Suppose p_1 and p_2 are the respective population proportions of the category. Calculate a confidence interval for $p_1 - p_2$ with confidence level $1 - \alpha = 0.95$.

	Sample 1	Sample 2
X	11.0000	191.0000
n	25.0000	436.0000
$\hat{p}$	0.4400	0.4380

Q105: Categorical counts from two independent samples are summarized in the following table, along with the sample sizes n. Suppose p_1 and p_2 are the respective population proportions of the category. Calculate a confidence interval for $p_1 - p_2$ with confidence level $1 - \alpha = 0.95$.

	Sample 1	Sample 2
X	147.0000	81.0000
n	381.0000	241.0000
$\hat{p}$	0.3860	0.3360

Q106: Categorical counts from two independent samples are summarized in the following table, along with the sample sizes n. Suppose p_1 and p_2 are the respective population proportions of the category. Calculate a confidence interval for $p_1 - p_2$ with confidence level $1 - \alpha = 0.95$.

	Sample 1	Sample 2
X	99.0000	23.0000
n	410.0000	86.0000
$\hat{p}$	0.2410	0.2670

Q107: Categorical counts from two independent samples are summarized in the following table, along with the sample sizes n. Suppose p_1 and p_2 are the respective population proportions of the category. Calculate a confidence interval for $p_1 - p_2$ with confidence level $1 - \alpha = 0.99$.

	Sample 1	Sample 2
X	276.0000	250.0000
n	467.0000	493.0000
$\hat{p}$	0.5910	0.5070

Q108: Categorical counts from two independent samples are summarized in the following table, along with the sample sizes n. Suppose p_1 and p_2 are the respective population proportions of the category. Calculate a confidence interval for $p_1 - p_2$ with confidence level $1 - \alpha = 0.9$.

	Sample 1	Sample 2
X	184.0000	3.0000
n	253.0000	9.0000
$\hat{p}$	0.7270	0.3330

Q109: Categorical counts from two independent samples are summarized in the following table, along with the sample sizes n. Suppose p_1 and p_2 are the respective population proportions of the category. Perfom a two-sided hypothesis test using hypotheses $H_o : p_1 - p_2 = 0$ against $H_a : p_1 - p_2 \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1	Sample 2
X	283.0000	149.0000
n	580.0000	402.0000
$\hat{p}$	0.4880	0.3710

Q110: Categorical counts from two independent samples are summarized in the following table, along with the sample sizes n. Suppose p_1 and p_2 are the respective population proportions of the category. Perfom a two-sided hypothesis test using hypotheses $H_o : p_1 - p_2 = 0$ against $H_a : p_1 - p_2 \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1	Sample 2
X	93.0000	152.0000
n	412.0000	449.0000
$\hat{p}$	0.2260	0.3390

Q111: Categorical counts from two independent samples are summarized in the following table, along with the sample sizes n. Suppose p_1 and p_2 are the respective population proportions of the category. Perfom a two-sided hypothesis test using hypotheses $H_o : p_1 - p_2 = 0$ against $H_a : p_1 - p_2 \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1	Sample 2
X	204.0000	375.0000
n	257.0000	479.0000
$\hat{p}$	0.7940	0.7830

Q112: Categorical counts from two independent samples are summarized in the following table, along with the sample sizes n. Suppose p_1 and p_2 are the respective population proportions of the category. Perfom a two-sided hypothesis test using hypotheses $H_o : p_1 - p_2 = 0$ against $H_a : p_1 - p_2 \neq 0$. Use significance level $\alpha = 0.1$.

	Sample 1	Sample 2
X	124.0000	77.0000
n	492.0000	229.0000
$\hat{p}$	0.2520	0.3360

Q113: Categorical counts from two independent samples are summarized in the following table, along with the sample sizes n. Suppose p_1 and p_2 are the respective population proportions of the category. Perfom a two-sided hypothesis test using hypotheses $H_o : p_1 - p_2 = 0$ against $H_a : p_1 - p_2 \neq 0$. Use significance level $\alpha = 0.01$.

	Sample 1	Sample 2
X	177.0000	97.0000
n	713.0000	344.0000
$\hat{p}$	0.2480	0.2820

Q114: Categorical counts from two independent samples are summarized in the following table, along with the sample sizes n. Suppose p_1 and p_2 are the respective population proportions of the category. Perfom a two-sided hypothesis test using hypotheses $H_o : p_1 - p_2 = 0$ against $H_a : p_1 - p_2 \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1	Sample 2
X	60.0000	12.0000
n	242.0000	84.0000
$\hat{p}$	0.2480	0.1430

Q115: Categorical counts from two independent samples are summarized in the following table, along with the sample sizes n. Suppose p_1 and p_2 are the respective population proportions of the category. Perfom a two-sided hypothesis test using hypotheses $H_o : p_1 - p_2 = 0$ against $H_a : p_1 - p_2 \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1	Sample 2
X	39.0000	156.0000
n	152.0000	402.0000
$\hat{p}$	0.2570	0.3880

Q116: Categorical counts from two independent samples are summarized in the following table, along with the sample sizes n. Suppose p_1 and p_2 are the respective population proportions of the category. Perfom a two-sided hypothesis test using hypotheses $H_o : p_1 - p_2 = 0$ against $H_a : p_1 - p_2 \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1	Sample 2
X	5.0000	104.0000
n	10.0000	257.0000
$\hat{p}$	0.5000	0.4050

Q117: Categorical counts from two independent samples are summarized in the following table, along with the sample sizes n. Suppose p_1 and p_2 are the respective population proportions of the category. Perfom a two-sided hypothesis test using hypotheses $H_o : p_1 - p_2 = 0$ against $H_a : p_1 - p_2 \neq 0$. Use significance level $\alpha = 0.1$.

	Sample 1	Sample 2
X	194.0000	121.0000
n	683.0000	271.0000
$\hat{p}$	0.2840	0.4460

Q118: Categorical counts from two independent samples are summarized in the following table, along with the sample sizes n. Suppose p_1 and p_2 are the respective population proportions of the category. Perfom a two-sided hypothesis test using hypotheses $H_o : p_1 - p_2 = 0$ against $H_a : p_1 - p_2 \neq 0$. Use significance level $\alpha = 0.01$.

	Sample 1	Sample 2
X	245.0000	97.0000
n	359.0000	143.0000
$\hat{p}$	0.6820	0.6780

1.5 Goodness of Fit Tests

Q119: The observed counts for $k = 4$ catogories based on a random sample of size $n = 18$ are given in the following table. Hypothetical population frequencies p_i are also given in the table. Use a χ^2 test for null hypothesis H_o : p_i are the true population frequencies. Use significance level $\alpha = 0.05$.

	1	2	3	4	Totals
Observed counts O_i	0.00	6.00	2.00	10.00	18.00
Hypothetical frequencies p_i	0.17	0.17	0.33	0.33	1.00
Observed frequencies $\hat{p}_i$	0.00	0.25	0.125	0.625	1.00

Q120: The observed counts for $k = 4$ catogories based on a random sample of size $n = 537$ are given in the following table. Hypothetical population frequencies p_i are also given in the table. Use a χ^2 test for null hypothesis H_o : p_i are the true population frequencies. Use significance level $\alpha = 0.1$.

	1	2	3	4	Totals
Observed counts O_i	295.00	99.00	99.00	44.00	537.00
Hypothetical frequencies p_i	0.56	0.19	0.19	0.06	1.00
Observed frequencies $\hat{p}_i$	0.55	0.18	0.18	0.08	1.00

Q121: The observed counts for $k = 6$ catogories based on a random sample of size $n = 238$ are given in the following table. Hypothetical population frequencies p_i are also given in the table. Use a χ^2 test for null hypothesis H_o : p_i are the true population frequencies. Use significance level $\alpha = 0.05$.

	1	2	3	4	5	6	Totals
Observed counts O_i	43.00	40.00	36.00	41.00	37.00	41.00	238.00
Hypothetical frequencies p_i	0.20	0.17	0.17	0.17	0.17	0.13	1.00
Observed frequencies $\hat{p}_i$	0.18	0.17	0.15	0.17	0.16	0.17	1.00

Q122: The observed counts for $k = 3$ catogories based on a random sample of size $n = 424$ are given in the following table. Hypothetical population frequencies p_i are also given in the table. Use a χ^2 test for null hypothesis H_o : p_i are the true population frequencies. Use significance level $\alpha = 0.05$.

	1	2	3	Totals
Observed counts O_i	125.00	201.00	98.00	424.00
Hypothetical frequencies p_i	0.25	0.50	0.25	1.00
Observed frequencies $\hat{p}_i$	0.29	0.47	0.23	1.00

Q123: The observed counts for $k = 4$ catogories based on a random sample of size $n = 183$ are given in the following table. Hypothetical population frequencies p_i are also given in the table. Use a χ^2 test for null hypothesis H_o : p_i are the true population frequencies. Use significance level $\alpha = 0.01$.

	1	2	3	4	Totals
Observed counts O_i	33.00	47.00	56.00	47.00	183.00
Hypothetical frequencies p_i	0.25	0.25	0.25	0.25	1.00
Observed frequencies $\hat{p}_i$	0.18	0.26	0.31	0.26	1.00

1.6 Tests for Independence in Contingency Tables

Q124: A contingency table with $n_r = 3$ rows and $n_c = 4$ columns based on a random sample of size $n = 556$ is given below. Hypothetical population frequencies of cell i, j are given by $p_{i,j}$. The population frequencies for the marginal row i and column j categories are given by r_i and c_j, respectively. Use a χ^2 test for the null hypothesis of row and column independence $H_o : p_{i,j} = r_i c_j$ for all i, j. Use significance level $\alpha = 0.05$.

	1	2	3	4	Totals
1	17.00	14.00	25.00	40.00	96.00
2	11.00	35.00	59.00	92.00	197.00
3	31.00	58.00	87.00	87.00	263.00
Totals	59.00	107.00	171.00	219.00	556.00

Table 1: Observed counts $O_{i,j}$

Q125: A contingency table with $n_r = 2$ rows and $n_c = 2$ columns based on a random sample of size $n = 80$ is given below. Hypothetical population frequencies of cell i, j are given by $p_{i,j}$. The population frequencies for the marginal row i and column j categories are given by r_i and c_j, respectively. Use a χ^2 test for the null hypothesis of row and column independence $H_o : p_{i,j} = r_i c_j$ for all i, j. Use significance level $\alpha = 0.1$.

	1	2	Totals
1	10.00	36.00	46.00
2	17.00	17.00	34.00
Totals	27.00	53.00	80.00

Table 2: Observed counts $O_{i,j}$

Q126: A contingency table with $n_r = 3$ rows and $n_c = 4$ columns based on a random sample of size $n = 255$ is given below. Hypothetical population frequencies of cell i, j are given by $p_{i,j}$. The population frequencies for the marginal row i and column j categories are given by r_i and c_j, respectively. Use a χ^2 test for the null hypothesis of row and column independence $H_o : p_{i,j} = r_i c_j$ for all i, j. Use significance level $\alpha = 0.05$.

	1	2	3	4	Totals
1	5.00	12.00	16.00	59.00	92.00
2	7.00	15.00	20.00	59.00	101.00
3	17.00	18.00	12.00	15.00	62.00
Totals	29.00	45.00	48.00	133.00	255.00

Table 3: Observed counts $O_{i,j}$

Q127: A contingency table with $n_r = 2$ rows and $n_c = 3$ columns based on a random sample of size $n = 378$ is given below. Hypothetical population frequencies of cell i, j are given by $p_{i,j}$. The population frequencies for the marginal row i and column j categories are given by r_i and c_j, respectively. Use a χ^2 test for the null hypothesis of row and column independence $H_o : p_{i,j} = r_i c_j$ for all i, j. Use significance level $\alpha = 0.05$.

	1	2	3	Totals
1	73.00	72.00	72.00	217.00
2	29.00	38.00	94.00	161.00
Totals	102.00	110.00	166.00	378.00

Table 4: Observed counts $O_{i,j}$

Q128: A contingency table with $n_r = 2$ rows and $n_c = 2$ columns based on a random sample of size $n = 143$ is given below. Hypothetical population frequencies of cell i, j are given by $p_{i,j}$. The population frequencies for the marginal row i and column j categories are given by r_i and c_j, respectively. Use a χ^2 test for the null hypothesis of row and column independence $H_o : p_{i,j} = r_i c_j$ for all i, j. Use significance level $\alpha = 0.01$.

	1	2	Totals
1	34.00	2.00	36.00
2	84.00	23.00	107.00
Totals	118.00	25.00	143.00

Table 5: Observed counts $O_{i,j}$

1.7 Inference for Odds Ratios

Q129: A contingency table, given below, gives frequencies for positive and negative outcomes O_+ and O_- for two groups of subjects based on independent samples. We are interested in estimating the odds ratio $OR = Odds(O_+ \mid Group1)/Odds(O_+ \mid Group2)$. Construct a confidence interval for $\log(OR)$ with confidence level $1-\alpha = 0.95$. Interpret the result as a two-sided test for null hypothesis $H_o : OR = 1$ against $H_a : OR \neq 1$.

	O_+	O_-
Group 1	155.0000	210.0000
Group 2	80.0000	10.0000

Q130: A contingency table, given below, gives frequencies for positive and negative outcomes O_+ and O_- for two groups of subjects based on independent samples. We are interested in estimating the odds ratio $OR = Odds(O_+ \mid Group1)/Odds(O_+ \mid Group2)$. Construct a confidence interval for $\log(OR)$ with confidence level $1-\alpha = 0.99$. Interpret the result as a two-sided test for null hypothesis $H_o : OR = 1$ against $H_a : OR \neq 1$.

	O_+	O_-
Group 1	78.0000	68.0000
Group 2	25.0000	6.0000

Q131: A contingency table, given below, gives frequencies for positive and negative outcomes O_+ and O_- for two groups of subjects based on independent samples. We are interested in estimating the odds ratio $OR = Odds(O_+ \mid Group1)/Odds(O_+ \mid Group2)$. Construct a confidence interval for $\log(OR)$ with confidence level $1-\alpha = 0.95$. Interpret the result as a two-sided test for null hypothesis $H_o : OR = 1$ against $H_a : OR \neq 1$.

	O_+	O_-
Group 1	193.0000	9.0000
Group 2	175.0000	9.0000

Q132: A contingency table, given below, gives frequencies for positive and negative outcomes O_+ and O_- for two groups of subjects based on independent samples. We are interested in estimating the odds ratio $OR = Odds(O_+ \mid Group1)/Odds(O_+ \mid Group2)$. Construct a confidence interval for $\log(OR)$ with confidence level $1-\alpha = 0.9$. Interpret the result as a two-sided test for null hypothesis $H_o : OR = 1$ against $H_a : OR \neq 1$.

	O_+	O_-
Group 1	65.0000	203.0000
Group 2	40.0000	73.0000

Q133: A contingency table, given below, gives frequencies for positive and negative outcomes O_+ and O_- for two groups of subjects based on independent samples. We are interested in estimating the odds ratio $OR = Odds(O_+ \mid Group1)/Odds(O_+ \mid Group2)$.

Construct a confidence interval for $\log(OR)$ with confidence level $1-\alpha = 0.95$. Interpret the result as a two-sided test for null hypothesis $H_o : OR = 1$ against $H_a : OR \neq 1$.

	O_+	O_-
Group 1	216.0000	187.0000
Group 2	213.0000	156.0000

Q134: A contingency table, given below, gives frequencies for positive and negative outcomes O_+ and O_- for two groups of subjects based on independent samples. We are interested in estimating the odds ratio $OR = Odds(O_+ \mid Group1)/Odds(O_+ \mid Group2)$. Construct a confidence interval for $\log(OR)$ with confidence level $1-\alpha = 0.95$. Interpret the result as a two-sided test for null hypothesis $H_o : OR = 1$ against $H_a : OR \neq 1$.

	O_+	O_-
Group 1	165.0000	91.0000
Group 2	250.0000	150.0000

Q135: A contingency table, given below, gives frequencies for positive and negative outcomes O_+ and O_- for two groups of subjects based on independent samples. We are interested in estimating the odds ratio $OR = Odds(O_+ \mid Group1)/Odds(O_+ \mid Group2)$. Construct a confidence interval for $\log(OR)$ with confidence level $1-\alpha = 0.99$. Interpret the result as a two-sided test for null hypothesis $H_o : OR = 1$ against $H_a : OR \neq 1$.

	O_+	O_-
Group 1	236.0000	129.0000
Group 2	107.0000	59.0000

1.8 ANOVA

Q137: Independent samples for $k = 3$ treatments are summarized in the table below. Assume sample j is from a normally distributed population with mean μ_j and fixed variance σ^2. Use a, F-test for null hypothesis $H_o : \mu_i = \mu_j$ for all i, j. Use significance level $\alpha = 0.05$.

	1	2	3	4	5	$\bar{X}_i$	S_i	n_i
Treatment 1	9.93	11.90	9.03	1.89	12.11	8.97	4.17	5.00
Treatment 2	8.37	11.43	14.72	7.67	2.79	9.00	4.45	5.00
Treatment 3	14.96	13.63	15.39	15.29	16.41	15.13	1.00	5.00

Construct confidence intervals for the following treatment differences using the Bonferroni procedure. Use a familywise error rate of $\alpha_{FWE} = 0.05$.

	Tr 1	Tr 2
Comp 1	1.00	3.00
Comp 2	2.00	3.00

Construct confidence intervals for the following treatment differences using the Tukey procedure. Use a familywise error rate of $\alpha_{FWE} = 0.05$.

	Tr 1	Tr 2
Comp 1	1.00	2.00
Comp 2	1.00	3.00
Comp 3	2.00	3.00

Q138: Independent samples for $k = 4$ treatments are summarized in the table below. Assume sample j is from a normally distributed population with mean μ_j and fixed variance σ^2. Use a, F-test for null hypothesis $H_o : \mu_i = \mu_j$ for all i, j. Use significance level $\alpha = 0.05$.

	1	2	3	4	5	6	$\bar{X}_i$	S_i	n_i
Treatment 1	18.93	24.81	20.16	26.74			22.66	3.72	4.00
Treatment 2	27.56	24.12	29.82				27.17	2.87	3.00
Treatment 3	21.66	20.84	38.14	19.04	24.09		24.75	7.70	5.00
Treatment 4	35.47	23.23	25.37	22.51	28.20	17.11	25.31	6.18	6.00

Construct confidence intervals for the following treatment differences using the Bonferroni procedure. Use a familywise error rate of $\alpha_{FWE} = 0.05$.

	Tr 1	Tr 2
Comp 1	1.00	4.00
Comp 2	2.00	3.00

Construct confidence intervals for the following treatment differences using the Tukey procedure. Use a familywise error rate of $\alpha_{FWE} = 0.05$.

	Tr 1	Tr 2
Comp 1	1.00	4.00
Comp 2	2.00	3.00

Q139: Independent samples for $k = 3$ treatments are summarized in the table below. Assume sample j is from a normally distributed population with mean μ_j and fixed variance σ^2. Use a, F-test for null hypothesis $H_o : \mu_i = \mu_j$ for all i, j. Use significance level $\alpha = 0.1$.

	1	2	3	4	5	6	7	$\bar{X}_i$	S_i	n_i
Treatment 1	-1.86	4.82	7.11	7.52	2.33	6.49	7.17	4.80	3.46	7.00
Treatment 2	4.83	2.95	4.92	8.51	9.87	14.49	8.57	7.73	3.89	7.00
Treatment 3	9.85	10.07	10.56	14.12	10.76			11.07	1.74	5.00

Construct confidence intervals for the following treatment differences using the Bonferroni procedure. Use a familywise error rate of $\alpha_{FWE} = 0.05$.

	Tr 1	Tr 2
Comp 1	1.00	2.00
Comp 2	1.00	3.00

Construct confidence intervals for the following treatment differences using the Tukey procedure. Use a familywise error rate of $\alpha_{FWE} = 0.05$.

	Tr 1	Tr 2
Comp 1	1.00	2.00
Comp 2	1.00	3.00

Q140: Independent samples for $k = 4$ treatments are summarized in the table below. Assume sample j is from a normally distributed population with mean μ_j and fixed variance σ^2. Use a, F-test for null hypothesis $H_o : \mu_i = \mu_j$ for all i, j. Use significance level $\alpha = 0.01$.

	1	2	3	4	$\bar{X}_i$	S_i	n_i
Treatment 1	0.60	4.71	5.39	6.99	4.43	2.72	4.00
Treatment 2	7.42	5.99	2.08	4.62	5.03	2.27	4.00
Treatment 3	5.18	7.07	3.84	6.68	5.69	1.48	4.00
Treatment 4	5.28	2.05	5.29	4.66	4.32	1.54	4.00

Construct confidence intervals for the following treatment differences using the Bonferroni procedure. Use a familywise error rate of $\alpha_{FWE} = 0.05$.

	Tr 1	Tr 2
Comp 1	2.00	1.00
Comp 2	2.00	3.00
Comp 3	2.00	4.00

Construct confidence intervals for the following treatment differences using the Tukey procedure. Use a familywise error rate of $\alpha_{FWE} = 0.05$.

	Tr 1	Tr 2
Comp 1	1.00	2.00
Comp 2	1.00	3.00
Comp 3	1.00	4.00
Comp 4	2.00	3.00
Comp 5	2.00	4.00
Comp 6	3.00	4.00

Q141: Independent samples for $k = 3$ treatments are summarized in the table below. Assume sample j is from a normally distributed population with mean μ_j and fixed variance σ^2. Use a, F-test for null hypothesis $H_o : \mu_i = \mu_j$ for all i, j. Use significance level $\alpha = 0.05$.

	1	2	3	4	5	6	$\bar{X}_i$	S_i	n_i
Treatment 1	19.43	25.81	23.08	22.69	18.13	28.34	22.91	3.82	6.00
Treatment 2	6.39	12.50	18.36	14.36	15.29	12.15	13.18	4.01	6.00
Treatment 3	14.45	19.55	22.27	25.96	26.61	18.15	21.16	4.70	6.00

Construct confidence intervals for the following treatment differences using the Bonferroni procedure. Use a familywise error rate of $\alpha_{FWE} = 0.05$.

	Tr 1	Tr 2
Comp 1	1.00	2.00
Comp 2	1.00	3.00
Comp 3	2.00	3.00

Construct confidence intervals for the following treatment differences using the Tukey procedure. Use a familywise error rate of $\alpha_{FWE} = 0.05$.

	Tr 1	Tr 2
Comp 1	1.00	2.00
Comp 2	1.00	3.00
Comp 3	2.00	3.00

1.9 Sign Tests

Q142: We are given two paired samples of sample size $n = 5$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform an upper tailed sign test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D > 0$. Use significance level $\alpha = 0.05$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	9.3	8.7	0.6	+
2	9.3	8.9	0.4	+
3	9.2	9.0	0.2	+
4	8.7	7.2	1.5	+
5	8.8	8.4	0.4	+

Q143: We are given two paired samples of sample size $n = 10$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform a two-sided sign test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	5.9	5.7	0.2	+
2	4.9	5.0	-0.1	-
3	4.9	4.4	0.5	+
4	5.3	5.4	-0.1	-
5	4.4	4.4	0.0	0
6	5.0	4.9	0.1	+
7	4.8	5.1	-0.3	-
8	5.5	5.5	0.0	0
9	5.0	5.4	-0.4	-
10	5.0	5.0	0.0	0

Q144: We are given two paired samples of sample size $n = 9$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform a two-sided sign test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	4.2	4.2	0.0	0
2	2.5	2.6	-0.1	-
3	3.7	4.1	-0.4	-
4	4.3	4.3	0.0	0
5	3.5	3.6	-0.1	-
6	2.5	2.6	-0.1	-
7	3.8	3.4	0.4	+
8	4.2	4.6	-0.4	-
9	4.6	4.9	-0.3	-

Q145: We are given two paired samples of sample size $n = 6$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform a two-sided sign test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D \neq 0$. Use significance level $\alpha = 0.01$.

	Sample 1 (X)	Sample 2 (Y)	Difference $(D = X - Y)$	Sign
1	8.2	7.0	1.2	+
2	5.4	5.0	0.4	+
3	6.3	4.4	1.9	+
4	8.0	6.5	1.5	+
5	4.2	4.3	-0.1	-
6	9.6	8.2	1.4	+

Q146: We are given two paired samples of sample size $n = 10$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform a two-sided sign test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D \neq 0$. Use significance level $\alpha = 0.1$.

	Sample 1 (X)	Sample 2 (Y)	Difference $(D = X - Y)$	Sign
1	14.5	14.5	0.0	0
2	15.4	16.4	-1.0	-
3	12.1	10.7	1.4	+
4	14.4	10.7	3.7	+
5	13.3	11.3	2.0	+
6	15.4	16.1	-0.7	-
7	15.0	14.7	0.3	+
8	13.0	15.5	-2.5	-
9	14.7	12.6	2.1	+
10	15.1	15.5	-0.4	-

Q147: We are given two paired samples of sample size $n = 7$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform a two-sided sign test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1 (X)	Sample 2 (Y)	Difference $(D = X - Y)$	Sign
1	5.5	5.8	-0.3	-
2	3.4	6.7	-3.3	-
3	3.9	3.3	0.6	+
4	4.4	3.9	0.5	+
5	2.9	3.8	-0.9	-
6	2.2	5.0	-2.8	-
7	3.3	4.9	-1.6	-

Q148: We are given two paired samples of sample size $n = 9$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform a lower tailed sign test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D < 0$. Use significance level $\alpha = 0.05$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	-2.0	1.6	-3.6	-
2	1.6	0.7	0.9	+
3	-0.5	13.1	-13.6	-
4	-6.0	-1.0	-5.0	-
5	-1.0	-1.0	0.0	0
6	1.4	5.4	-4.0	-
7	2.9	8.5	-5.6	-
8	2.3	6.5	-4.2	-
9	3.5	5.2	-1.7	-

Q149: We are given two paired samples of sample size $n = 5$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform a two-sided sign test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	12.2	12.5	-0.3	-
2	12.1	11.9	0.2	+
3	12.5	12.7	-0.2	-
4	12.3	12.4	-0.1	-
5	12.4	12.4	0.0	0

Q150: We are given two paired samples of sample size $n = 6$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform a lower tailed sign test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D < 0$. Use significance level $\alpha = 0.01$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	2.6	3.2	-0.6	-
2	3.0	3.7	-0.7	-
3	3.5	4.1	-0.6	-
4	2.4	2.7	-0.3	-
5	2.7	2.9	-0.2	-
6	3.1	3.4	-0.3	-

Q151: We are given two paired samples of sample size $n = 10$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform a two-sided sign test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D \neq 0$. Use significance level $\alpha = 0.1$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	6.6	5.7	0.9	+
2	7.2	9.1	-1.9	-
3	8.1	8.8	-0.7	-
4	7.3	7.0	0.3	+
5	6.7	7.6	-0.9	-
6	11.1	11.4	-0.3	-
7	7.6	7.5	0.1	+
8	6.4	6.7	-0.3	-
9	6.6	5.9	0.7	+
10	8.9	7.3	1.6	+

Q152: We are given two paired samples of sample size $n = 7$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform a two-sided sign test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	16.9	16.9	0.0	0
2	18.2	18.6	-0.4	-
3	18.2	17.3	0.9	+
4	17.9	18.2	-0.3	-
5	18.3	18.9	-0.6	-
6	18.4	18.0	0.4	+
7	17.3	17.4	-0.1	-

Q153: We are given two paired samples of sample size $n = 8$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform a two-sided sign test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	4.1	5.1	-1.0	-
2	3.8	4.8	-1.0	-
3	4.3	3.5	0.8	+
4	5.7	6.5	-0.8	-
5	4.0	4.9	-0.9	-
6	3.4	2.1	1.3	+
7	5.7	6.3	-0.6	-
8	5.4	5.3	0.1	+

Q154: We are given two paired samples of sample size $n = 10$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences

$D = X - Y$. Perform a two-sided sign test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	4.5	4.7	-0.2	-
2	4.6	4.8	-0.2	-
3	4.2	4.2	0.0	0
4	4.6	4.6	0.0	0
5	4.5	4.9	-0.4	-
6	4.2	4.6	-0.4	-
7	4.8	4.8	0.0	0
8	4.5	4.7	-0.2	-
9	3.7	3.7	0.0	0
10	4.4	3.9	0.5	+

Q155: We are given two paired samples of sample size $n = 6$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform an upper tailed sign test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D > 0$. Use significance level $\alpha = 0.01$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	5.0	2.5	2.5	+
2	6.5	4.7	1.8	+
3	4.7	1.8	2.9	+
4	6.8	3.3	3.5	+
5	5.6	2.8	2.8	+
6	6.8	0.3	6.5	+

Q156: We are given two paired samples of sample size $n = 9$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform a two-sided sign test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D \neq 0$. Use significance level $\alpha = 0.1$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	6.3	6.2	0.1	+
2	6.0	6.0	0.0	0
3	6.3	6.1	0.2	+
4	5.9	6.0	-0.1	-
5	6.0	6.1	-0.1	-
6	6.0	6.1	-0.1	-
7	6.1	6.0	0.1	+
8	6.2	6.5	-0.3	-
9	6.2	6.5	-0.3	-

1.10 Signed Rank Tests

Q157: We are given two paired samples of sample size $n = 7$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform a two-sided signed rank test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	2.8	1.9	0.9	+
2	6.7	8.5	-1.8	-
3	-0.8	-1.0	0.2	+
4	2.1	3.0	-0.9	-
5	1.1	0.5	0.6	+
6	7.3	6.0	1.3	+
7	-2.0	-4.0	2.0	+

Q158: We are given two paired samples of sample size $n = 8$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform a two-sided signed rank test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	4.8	2.9	1.9	+
2	8.3	4.0	4.3	+
3	4.8	5.3	-0.5	-
4	7.1	4.8	2.3	+
5	15.0	10.3	4.7	+
6	15.3	10.1	5.2	+
7	0.8	-5.0	5.8	+
8	3.7	-2.0	5.7	+

Q159: We are given two paired samples of sample size $n = 5$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform a two-sided signed rank test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	11.4	14.8	-3.4	-
2	-2.0	-5.0	3.0	+
3	-1.0	2.7	-3.7	-
4	2.9	10.4	-7.5	-
5	3.1	0.5	2.6	+

Q160: We are given two paired samples of sample size $n = 7$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform an upper tailed signed rank test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D > 0$. Use significance level $\alpha = 0.01$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	11.2	16.8	-5.6	-
2	12.3	7.1	5.2	+
3	17.7	15.6	2.1	+
4	17.4	17.4	0.0	0
5	8.7	2.0	6.7	+
6	14.0	9.8	4.2	+
7	15.4	17.2	-1.8	-

Q161: We are given two paired samples of sample size $n = 7$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform an upper tailed signed rank test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D > 0$. Use significance level $\alpha = 0.1$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	6.0	4.3	1.7	+
2	4.1	2.3	1.8	+
3	4.7	1.9	2.8	+
4	5.7	5.3	0.4	+
5	7.0	7.2	-0.2	-
6	5.6	4.4	1.2	+
7	7.7	8.0	-0.3	-

Q162: We are given two paired samples of sample size $n = 9$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform an upper tailed signed rank test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D > 0$. Use significance level $\alpha = 0.05$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	9.5	3.9	5.6	+
2	10.1	4.7	5.4	+
3	8.8	11.4	-2.6	-
4	3.3	1.2	2.1	+
5	9.0	10.7	-1.7	-
6	13.1	14.0	-0.9	-
7	12.3	9.0	3.3	+
8	12.2	5.4	6.8	+
9	8.4	5.1	3.3	+

Q163: We are given two paired samples of sample size $n = 10$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform an upper tailed signed rank test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D > 0$. Use significance level $\alpha = 0.05$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	8.1	5.6	2.5	+
2	2.4	-0.9	3.3	+
3	2.2	-1.0	3.2	+
4	-1.0	-2.0	1.0	+
5	0.9	-2.0	2.9	+
6	2.0	1.8	0.2	+
7	-0.9	-3.0	2.1	+
8	-0.7	-2.0	1.3	+
9	1.1	1.5	-0.4	-
10	-2.0	-3.0	1.0	+

Q164: We are given two paired samples of sample size $n = 5$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform a two-sided signed rank test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	5.5	6.1	-0.6	-
2	4.5	3.2	1.3	+
3	5.8	2.9	2.9	+
4	6.4	3.0	3.4	+
5	9.9	8.2	1.7	+

Q165: We are given two paired samples of sample size $n = 9$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform a lower tailed signed rank test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D < 0$. Use significance level $\alpha = 0.01$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	2.8	3.2	-0.4	-
2	5.9	11.6	-5.7	-
3	2.7	2.7	0.0	0
4	7.0	10.6	-3.6	-
5	0.9	-2.0	2.9	+
6	-3.0	-5.0	2.0	+
7	2.7	2.6	0.1	+
8	6.6	10.4	-3.8	-
9	2.7	1.5	1.2	+

Q166: We are given two paired samples of sample size $n = 7$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform an upper tailed signed rank test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D > 0$. Use significance level $\alpha = 0.1$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	32.7	30.9	1.8	+
2	29.1	27.0	2.1	+
3	29.7	26.7	3.0	+
4	33.6	33.6	0.0	0
5	30.5	32.3	-1.8	-
6	25.5	23.2	2.3	+
7	36.6	35.1	1.5	+

Q167: We are given two paired samples of sample size $n = 6$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform a lower tailed signed rank test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D < 0$. Use significance level $\alpha = 0.05$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	9.7	9.2	0.5	+
2	11.2	13.7	-2.5	-
3	14.6	15.7	-1.1	-
4	11.0	9.5	1.5	+
5	11.3	11.3	0.0	0
6	9.8	10.9	-1.1	-

Q168: We are given two paired samples of sample size $n = 9$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform a lower tailed signed rank test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D < 0$. Use significance level $\alpha = 0.05$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	34.4	36.3	-1.9	-
2	32.8	34.5	-1.7	-
3	34.3	36.0	-1.7	-
4	34.4	35.6	-1.2	-
5	33.6	34.7	-1.1	-
6	34.7	34.0	0.7	+
7	34.5	35.9	-1.4	-
8	31.7	31.3	0.4	+
9	33.6	34.6	-1.0	-

Q169: We are given two paired samples of sample size $n = 10$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform a two-sided signed rank test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D \neq 0$. Use significance level $\alpha = 0.05$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	19.2	19.8	-0.6	-
2	19.4	19.5	-0.1	-
3	21.1	18.0	3.1	+
4	21.0	19.0	2.0	+
5	20.6	21.4	-0.8	-
6	21.0	23.8	-2.8	-
7	24.9	24.4	0.5	+
8	21.9	24.9	-3.0	-
9	22.3	21.0	1.3	+
10	22.7	23.3	-0.6	-

Q170: We are given two paired samples of sample size $n = 9$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform an upper tailed signed rank test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D > 0$. Use significance level $\alpha = 0.01$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	0.6	-3.0	3.6	+
2	0.7	3.6	-2.9	-
3	1.7	1.5	0.2	+
4	2.0	-0.4	2.4	+
5	3.7	6.4	-2.7	-
6	1.7	-0.3	2.0	+
7	3.2	0.7	2.5	+
8	2.1	-4.0	6.1	+
9	3.4	1.4	2.0	+

Q171: We are given two paired samples of sample size $n = 7$. The data is summarized in the table below. Suppose $\tilde{\mu}_D$ is the population median of the paired differences $D = X - Y$. Perform an upper tailed signed rank test using hypotheses $H_o : \tilde{\mu}_D = 0$ against $H_a : \tilde{\mu}_D > 0$. Use significance level $\alpha = 0.1$.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Sign
1	4.4	3.1	1.3	+
2	4.6	6.2	-1.6	-
3	4.7	6.2	-1.5	-
4	4.7	4.3	0.4	+
5	4.8	3.8	1.0	+
6	5.4	6.4	-1.0	-
7	4.5	4.5	0.0	0

1.11 Rank Sum Tests

Q172: We are given two independent samples of sample sizes $n_1 = 7$, $n_2 = 4$. The data is summarized in the table below. Suppose $\tilde{\mu_i}$ is the population median of sample i. Perform an upper tailed rank sum test using hypotheses $H_o : \tilde{\mu_1} - \tilde{\mu_2} = 0$ against $H_a : \tilde{\mu_1} - \tilde{\mu_2} > 0$. Use significance level $\alpha = 0.01$.

	1	2	3	4	5	6	7	$\tilde{X_i}$
Sample 1	6.1	6.4	5.2	6.1	5.5	4.3	5.6	5.6
Sample 2	1.2	2.7	2.3	2.9				2.5

Q173: We are given two independent samples of sample sizes $n_1 = 7$, $n_2 = 9$. The data is summarized in the table below. Suppose $\tilde{\mu_i}$ is the population median of sample i. Perform a two-sided rank sum test using hypotheses $H_o : \tilde{\mu_1} - \tilde{\mu_2} = 0$ against $H_a : \tilde{\mu_1} - \tilde{\mu_2} \neq 0$. Use significance level $\alpha = 0.05$.

	1	2	3	4	5	6	7	8	9	$\tilde{X_i}$
Sample 1	3.6	3.4	2.2	2.9	3.8	2.5	4.4			3.4
Sample 2	-4.0	-5.0	-5.0	-5.0	-4.0	-5.0	-7.0	-4.0	-5.0	-5.0

Q174: We are given two independent samples of sample sizes $n_1 = 8$, $n_2 = 4$. The data is summarized in the table below. Suppose $\tilde{\mu_i}$ is the population median of sample i. Perform a two-sided rank sum test using hypotheses $H_o : \tilde{\mu_1} - \tilde{\mu_2} = 0$ against $H_a : \tilde{\mu_1} - \tilde{\mu_2} \neq 0$. Use significance level $\alpha = 0.05$.

	1	2	3	4	5	6	7	8	$\tilde{X_i}$
Sample 1	11.3	11.2	6.8	5.6	6.8	8.0	8.8	10.9	8.4
Sample 2	17.9	18.0	17.3	18.6					17.9

Q175: We are given two independent samples of sample sizes $n_1 = 5$, $n_2 = 7$. The data is summarized in the table below. Suppose $\tilde{\mu_i}$ is the population median of sample i. Perform a two-sided rank sum test using hypotheses $H_o : \tilde{\mu_1} - \tilde{\mu_2} = 0$ against $H_a : \tilde{\mu_1} - \tilde{\mu_2} \neq 0$. Use significance level $\alpha = 0.05$.

	1	2	3	4	5	6	7	$\tilde{X}_i$
Sample 1	4.9	5.0	4.6	4.2	4.9			4.9
Sample 2	3.5	3.2	3.7	4.1	3.9	3.7	2.8	3.7

Q176: We are given two independent samples of sample sizes $n_1 = 7$, $n_2 = 6$. The data is summarized in the table below. Suppose $\tilde{\mu_i}$ is the population median of sample i. Perform a two-sided rank sum test using hypotheses $H_o : \tilde{\mu_1} - \tilde{\mu_2} = 0$ against $H_a : \tilde{\mu_1} - \tilde{\mu_2} \neq 0$. Use significance level $\alpha = 0.1$.

	1	2	3	4	5	6	7	$\tilde{X}_i$
Sample 1	2.6	2.0	4.6	-1.0	3.8	4.6	2.8	2.8
Sample 2	-10.0	-10.0	-20.0	-20.0	-20.0	-20.0		-20.0

Q177: We are given two independent samples of sample sizes $n_1 = 6$, $n_2 = 9$. The data is summarized in the table below. Suppose $\tilde{\mu_i}$ is the population median of sample i. Perform a two-sided rank sum test using hypotheses $H_o : \tilde{\mu_1} - \tilde{\mu_2} = 0$ against $H_a : \tilde{\mu_1} - \tilde{\mu_2} \neq 0$. Use significance level $\alpha = 0.01$.

	1	2	3	4	5	6	7	8	9	$\tilde{X}_i$
Sample 1	-3.0	-1.0	-0.1	0.1	-0.3	4.5				-0.2
Sample 2	7.9	7.1	-5.0	1.7	-3.0	6.0	0.2	2.2	-8.0	1.7

Q178: We are given two independent samples of sample sizes $n_1 = 5$, $n_2 = 6$. The data is summarized in the table below. Suppose $\tilde{\mu_i}$ is the population median of sample i. Perform a lower tailed rank sum test using hypotheses $H_o : \tilde{\mu_1} - \tilde{\mu_2} = 0$ against $H_a : \tilde{\mu_1} - \tilde{\mu_2} < 0$. Use significance level $\alpha = 0.05$.

	1	2	3	4	5	6	$\tilde{X}_i$
Sample 1	8.1	6.6	6.4	7.2	8.2		7.2
Sample 2	8.3	11.6	10.7	10.1	7.6	8.8	9.4

Q179: We are given two independent samples of sample sizes $n_1 = 4$, $n_2 = 8$. The data is summarized in the table below. Suppose $\tilde{\mu_i}$ is the population median of sample i. Perform an upper tailed rank sum test using hypotheses $H_o : \tilde{\mu_1} - \tilde{\mu_2} = 0$ against $H_a : \tilde{\mu_1} - \tilde{\mu_2} > 0$. Use significance level $\alpha = 0.05$.

	1	2	3	4	5	6	7	8	$\tilde{X}_i$
Sample 1	9.7	9.1	10.0	7.9					9.4
Sample 2	8.1	6.8	7.8	8.8	8.2	8.9	8.4	6.9	8.1

Q180: We are given two independent samples of sample sizes $n_1 = 4$, $n_2 = 7$. The data is summarized in the table below. Suppose $\tilde{\mu_i}$ is the population median of sample

i. Perform an upper tailed rank sum test using hypotheses $H_o: \tilde{\mu_1} - \tilde{\mu_2} = 0$ against $H_a: \tilde{\mu_1} - \tilde{\mu_2} > 0$. Use significance level $\alpha = 0.05$.

	1	2	3	4	5	6	7	$\tilde{X}_i$
Sample 1	22.8	25.4	23.6	20.6				23.2
Sample 2	23.3	22.2	23.5	18.8	21.4	23.7	19.9	22.2

Q181: We are given two independent samples of sample sizes $n_1 = 9$, $n_2 = 5$. The data is summarized in the table below. Suppose $\tilde{\mu_i}$ is the population median of sample i. Perform a lower tailed rank sum test using hypotheses $H_o: \tilde{\mu_1} - \tilde{\mu_2} = 0$ against $H_a: \tilde{\mu_1} - \tilde{\mu_2} < 0$. Use significance level $\alpha = 0.1$.

	1	2	3	4	5	6	7	8	9	$\tilde{X}_i$
Sample 1	-2.0	6.7	1.4	9.4	3.6	5.6	6.1	0.5	0.8	3.6
Sample 2	19.0	12.6	14.0	12.8	18.6					14.0

Q182: We are given two independent samples of sample sizes $n_1 = 9$, $n_2 = 7$. The data is summarized in the table below. Suppose $\tilde{\mu_i}$ is the population median of sample i. Perform an upper tailed rank sum test using hypotheses $H_o: \tilde{\mu_1} - \tilde{\mu_2} = 0$ against $H_a: \tilde{\mu_1} - \tilde{\mu_2} > 0$. Use significance level $\alpha = 0.01$.

	1	2	3	4	5	6	7	8	9	$\tilde{X}_i$
Sample 1	2.5	-0.8	2.6	3.3	2.4	1.2	-0.7	0.7	2.0	2.0
Sample 2	-1.0	2.6	1.1	3.6	-0.9	1.1	-1.0			1.1

Q183: We are given two independent samples of sample sizes $n_1 = 6$, $n_2 = 9$. The data is summarized in the table below. Suppose $\tilde{\mu_i}$ is the population median of sample i. Perform an upper tailed rank sum test using hypotheses $H_o: \tilde{\mu_1} - \tilde{\mu_2} = 0$ against $H_a: \tilde{\mu_1} - \tilde{\mu_2} > 0$. Use significance level $\alpha = 0.05$.

	1	2	3	4	5	6	7	8	9	$\tilde{X}_i$
Sample 1	9.6	9.0	8.3	9.3	8.1	8.4				8.7
Sample 2	6.4	8.2	6.7	7.5	7.3	7.8	6.7	6.2	6.7	6.7

Q184: We are given two independent samples of sample sizes $n_1 = 8$, $n_2 = 4$. The data is summarized in the table below. Suppose $\tilde{\mu_i}$ is the population median of sample i. Perform a two-sided rank sum test using hypotheses $H_o: \tilde{\mu_1} - \tilde{\mu_2} = 0$ against $H_a: \tilde{\mu_1} - \tilde{\mu_2} \neq 0$. Use significance level $\alpha = 0.05$.

	1	2	3	4	5	6	7	8	$\tilde{X}_i$
Sample 1	12.5	22.2	18.4	9.3	25.0	18.1	10.6	21.0	18.2
Sample 2	19.6	32.6	31.2	23.1					27.1

Q185: We are given two independent samples of sample sizes $n_1 = 6$, $n_2 = 5$. The data is summarized in the table below. Suppose $\tilde{\mu_i}$ is the population median of sample i. Perform an upper tailed rank sum test using hypotheses $H_o : \tilde{\mu_1} - \tilde{\mu_2} = 0$ against $H_a : \tilde{\mu_1} - \tilde{\mu_2} > 0$. Use significance level $\alpha = 0.05$.

	1	2	3	4	5	6	$\tilde{X}_i$
Sample 1	8.0	7.3	4.4	3.4	7.7	6.9	7.1
Sample 2	-6.0	-0.8	-3.0	-3.0	-4.0		-3.0

Q186: We are given two independent samples of sample sizes $n_1 = 9$, $n_2 = 4$. The data is summarized in the table below. Suppose $\tilde{\mu_i}$ is the population median of sample i. Perform a two-sided rank sum test using hypotheses $H_o : \tilde{\mu_1} - \tilde{\mu_2} = 0$ against $H_a : \tilde{\mu_1} - \tilde{\mu_2} \neq 0$. Use significance level $\alpha = 0.1$.

	1	2	3	4	5	6	7	8	9	$\tilde{X}_i$
Sample 1	6.1	6.9	5.4	4.0	5.5	5.1	5.1	4.7	5.4	5.4
Sample 2	-2.0	-3.0	-4.0	-6.0						-3.5

2 Answers

Q1 [Answer]: (9.478,10.61) or 10.044 $\pm$ 0.566

Q2 [Answer]: (-3.89,-1.53) or -2.71 $\pm$ 1.176

Q3 [Answer]: (12.829,13.929) or 13.379 $\pm$ 0.55

Q4 [Answer]: (31.513,38.211) or 34.862 $\pm$ 3.349

Q5 [Answer]: The confidence interval is (0.00187,0.00247) . The lower and upper confidence bounds are, respectively, 0.00191 and 0.00241

Q6 [Answer]: The confidence interval is (1.424,9.081) . The lower and upper confidence bounds are, respectively, 1.5 and 7.827

Q7 [Answer]: The confidence interval is (237.473,423.09) . The lower and upper confidence bounds are, respectively, 246.901 and 400.372

Q8 [Answer]: The confidence interval is (10.993,12.412) . The lower and upper confidence bounds are, respectively, 11.136 and 12.241

Q9 [Answer]: $Z = 3.148$. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2} = 1.96$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.001642. The level $1 - \alpha = 0.95$ CI is (175.722, 191.728).

Q10 [Answer]: $T = 3.111$. Reject H_o if $|T|$ is greater than or equal to $t_{n-1,\alpha/2} = 2.101$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.003014. The level $1 - \alpha = 0.95$ CI is (139.182, 154.114).

Q11 [Answer]: $Z = 6.987$. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2} = 1.96$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 2.799e-12. The level $1 - \alpha = 0.95$ CI is (128.272, 133.83).

Q12 [Answer]: T = -0.149. Reject H_o if T is greater than or equal to $t_{n-1,\alpha} = 2.379$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.01$. P-value = 0.5591. The level $1 - \alpha = 0.99$ CI is (524.368, 556.594).

Q13 [Answer]: $T = 3.201$. Reject H_o if T is greater than or equal to $t_{n-1,\alpha} = 1.29$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.1$. P-value = 0.0009224. The level $1 - \alpha = 0.9$ CI is (5.523, 5.707).

Q14 [Answer]: $T = 2.862$. Reject H_o if T is greater than or equal to $t_{n-1,\alpha} = 1.673$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.002956. The level $1 - \alpha = 0.95$ CI is (40.285, 42.607).

Q15 [Answer]: $T = 1.339$. Reject H_o if $|T|$ is greater than or equal to $t_{n-1,\alpha/2} = 1.984$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.09188. The level $1 - \alpha = 0.95$ CI is (102.342, 106.386).

Q16 [Answer]: $T = 3.228$. Reject H_o if $|T|$ is greater than or equal to $t_{n-1,\alpha/2} = 2.074$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.001932. The level $1 - \alpha = 0.95$ CI is (50.439, 55.289).

Q17 [Answer]: $T = 7.435$. Reject H_o if $|T|$ is greater than or equal to $t_{n-1,\alpha/2} = 2.649$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.01$. P-value = 1.079e-10. The level $1 - \alpha = 0.99$ CI is (67.772, 72.384).

Q18 [Answer]: $Z = 4.588$. Reject H_o if Z is greater than or equal to $z_\alpha = 1.282$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.1$. P-value = 2.241e-06. The level $1 - \alpha = 0.9$ CI is (91.358, 94.93).

Q19 [Answer]: $T = 3.581$. Reject H_o if T is greater than or equal to $t_{n-1,\alpha} = 1.673$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.0003619. The level $1 - \alpha = 0.95$ CI is (72.575, 76.751).

Q20 [Answer]: $T = 1.545$. Reject H_o if T is greater than or equal to $t_{n-1,\alpha} = 1.812$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.07668. The level $1 - \alpha = 0.95$ CI is (65.617, 74.863).

Q21 [Answer]: $Z = 4.551$. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2} = 1.96$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 5.337e-06. The level $1 - \alpha = 0.95$ CI is (341.115, 356.137).

Q22 [Answer]: $T = 0.258$. Reject H_o if T is greater than or equal to $t_{n-1,\alpha} = 2.397$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.01$. P-value = 0.3988. The level $1 - \alpha = 0.99$ CI is (10.893, 11.729).

Q23 [Answer]: $T = 1.797$. Reject H_o if T is greater than or equal to $t_{n-1,\alpha} = 1.29$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.1$. P-value = 0.03774. The level $1 - \alpha = 0.9$ CI is (1.782, 1.84).

Q24 [Answer]: $Z = 1.756$. Reject H_o if Z is greater than or equal to $z_\alpha = 1.645$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.03954. The level $1 - \alpha = 0.95$ CI is (13.937, 14.643).

Q25 [Answer]: $Z = 0.0334$. Reject H_o if Z is greater than or equal to $z_\alpha = 1.645$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.4867. The level $1 - \alpha = 0.95$ CI is (28.358, 29.55).

Q26 [Answer]: $Z = 4.98$. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2} = 1.96$.

Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 6.342e-07. The level $1 - \alpha = 0.95$ CI is (76.9, 82.814).

Q27 [Answer]: $Z = 5.531$. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2} = 2.576$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.01$. P-value = 3.182e-08. The level $1 - \alpha = 0.99$ CI is (15.509, 16.943).

Q28 [Answer]: $Z = 1.56$. Reject H_o if Z is greater than or equal to $z_\alpha = 1.282$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.1$. P-value = 0.05934. The level $1 - \alpha = 0.9$ CI is (232.926, 263.712).

Q29 [Answer]: (-0.952,0.456) or -0.248 $\pm$ 0.704

Q30 [Answer]: (-0.0407,1.437) or 0.698 $\pm$ 0.739

Q31 [Answer]: $F = 0.928$. Reject $H_o : \sigma_1^2 = \sigma_2^2$ if F is less than or equal to $F_{1-\alpha/2,n_1-1,n_2-1} = 0.515$ or if F is greater than or equal to $F_{\alpha/2,n_1-1,n_2-1} = 1.819$, where $\alpha = 0.05$. Therefore, do not reject the null hypothesis of equal variances at a significance level $\alpha = 0.05$. P-value = 0.8421. Use the pooled procedure with $\nu = 89$ degrees of freedom. The confidence intervals are (0.0986,0.547) or 0.323 $\pm$ 0.224.

Q32 [Answer]: $F = 1.628$. Reject $H_o : \sigma_1^2 = \sigma_2^2$ if F is less than or equal to $F_{1-\alpha/2,n_1-1,n_2-1} = 0.597$ or if F is greater than or equal to $F_{\alpha/2,n_1-1,n_2-1} = 1.761$, where $\alpha = 0.05$. Therefore, do not reject the null hypothesis of equal variances at a significance level $\alpha = 0.05$. P-value = 0.09061. Use the pooled procedure with $\nu = 122$ degrees of freedom. The confidence intervals are (-0.607,-0.235) or -0.421 $\pm$ 0.186.

Q33 [Answer]: (-1.34,1.807) or 0.232 $\pm$ 1.575

Q34 [Answer]: $F = 1.96$. Reject $H_o : \sigma_1^2 = \sigma_2^2$ if F is less than or equal to $F_{1-\alpha/2,n_1-1,n_2-1} = 0.254$ or if F is greater than or equal to $F_{\alpha/2,n_1-1,n_2-1} = 2.753$, where $\alpha = 0.05$. Therefore, do not reject the null hypothesis of equal variances at a significance level $\alpha = 0.05$. P-value = 0.1898. Use the pooled procedure with $\nu = 33$ degrees of freedom. The confidence intervals are (-0.588,0.382) or -0.103 $\pm$ 0.485.

Q35 [Answer]: $F = 1.108$. Reject $H_o : \sigma_1^2 = \sigma_2^2$ if F is less than or equal to $F_{1-\alpha/2,n_1-1,n_2-1} = 0.655$ or if F is greater than or equal to $F_{\alpha/2,n_1-1,n_2-1} = 1.533$, where $\alpha = 0.05$. Therefore, do not reject the null hypothesis of equal variances at a significance level $\alpha = 0.05$. P-value = 0.6378. Use the pooled procedure with $\nu = 173$ degrees of freedom. The confidence intervals are (-0.321,-0.0528) or -0.187 $\pm$ 0.134.

Q36 [Answer]: (-0.0319,0.196) or 0.082 $\pm$ 0.114

Q37 [Answer]: $F = 1.943$. Reject $H_o : \sigma_1^2 = \sigma_2^2$ if F is less than or equal to $F_{1-\alpha/2,n_1-1,n_2-1} = 0.372$ or if F is greater than or equal to $F_{\alpha/2,n_1-1,n_2-1} = 2.243$, where $\alpha = 0.05$. Therefore, do not reject the null hypothesis of equal variances at a significance level $\alpha = 0.05$. P-value = 0.1069. Use the pooled procedure with $\nu = 51$ degrees of freedom. The confidence intervals are (-0.534,0.0278) or -0.253 $\pm$ 0.281.

Q38 [Answer]: $F = 2.389$. Reject $H_o : \sigma_1^2 = \sigma_2^2$ if F is less than or equal to $F_{1-\alpha/2,n_1-1,n_2-1} = 0.653$ or if F is greater than or equal to $F_{\alpha/2,n_1-1,n_2-1} = 1.558$, where $\alpha = 0.05$. Therefore, reject the null hypothesis of equal variances at a significance level $\alpha = 0.05$. P-value = 0.000159. Use Welch's procedure with $\nu = 168$ degrees of freedom. The confidence intervals are (-0.361,0.845) or 0.242 $\pm$ 0.603.

Q39 [Answer]: (0.787,1.369) or 1.078 $\pm$ 0.291

Q40 [Answer]: F = 0.466. Reject $H_o : \sigma_1^2 = \sigma_2^2$ if F is less than or equal to $F_{1-\alpha/2,n_1-1,n_2-1}$ = 0.436 or if F is greater than or equal to $F_{\alpha/2,n_1-1,n_2-1}$ = 3.429, where α = 0.05. Therefore, do not reject the null hypothesis of equal variances at a significance level α = 0.05. P-value = 0.07174. Use the pooled procedure with ν = 82 degrees of freedom. The confidence intervals are (0.777,2.563) or 1.67 $\pm$ 0.893.

Q41 [Answer]: (-0.259,0.307) or 0.024 $\pm$ 0.283

Q42 [Answer]: F = 0.733. Reject $H_o : \sigma_1^2 = \sigma_2^2$ if F is less than or equal to $F_{1-\alpha/2,n_1-1,n_2-1}$ = 0.588 or if F is greater than or equal to $F_{\alpha/2,n_1-1,n_2-1}$ = 1.837, where α = 0.05. Therefore, do not reject the null hypothesis of equal variances at a significance level α = 0.05. P-value = 0.2497. Use the pooled procedure with ν = 126 degrees of freedom. The confidence intervals are (-0.298,-0.146) or -0.222 $\pm$ 0.0764.

Q43 [Answer]: (0.0898,0.844) or 0.467 $\pm$ 0.377

Q44 [Answer]: F = 0.664. Reject $H_o : \sigma_1^2 = \sigma_2^2$ if F is less than or equal to $F_{1-\alpha/2,n_1-1,n_2-1}$ = 0.541 or if F is greater than or equal to $F_{\alpha/2,n_1-1,n_2-1}$ = 2.17, where α = 0.05. Therefore, do not reject the null hypothesis of equal variances at a significance level α = 0.05. P-value = 0.1912. Use the pooled procedure with ν = 120 degrees of freedom. The confidence intervals are (-0.69,-0.0983) or -0.394 $\pm$ 0.296.

Q45 [Answer]: (-0.859,-0.415) or -0.637 $\pm$ 0.222

Q46 [Answer]: (-0.725,2.817) or 1.046 $\pm$ 1.771

Q47 [Answer]: F = 0.52. Reject $H_o : \sigma_1^2 = \sigma_2^2$ if F is less than or equal to $F_{1-\alpha/2,n_1-1,n_2-1}$ = 0.468 or if F is greater than or equal to $F_{\alpha/2,n_1-1,n_2-1}$ = 1.848, where α = 0.05. Therefore, do not reject the null hypothesis of equal variances at a significance level α = 0.05. P-value = 0.08969. Use the pooled procedure with ν = 110 degrees of freedom. The confidence intervals are (-0.693,-0.0294) or -0.361 $\pm$ 0.332.

Q48 [Answer]: (-0.773,0.0726) or -0.35 $\pm$ 0.423

Q49 [Answer]: Z = -3.39. Reject H_o if Z is less than or equal to $-z_\alpha$ = -1.64. Therefore, reject the null hypothesis at a significance level α = 0.05. P-value = 0.0003516. The level $1-\alpha$ = 0.95 CI is (-4.77, -1.28).

Q50 [Answer]: F = 0.912. Reject $H_o : \sigma_1^2 = \sigma_2^2$ if F is less than or equal to $F_{1-\alpha/2,n_1-1,n_2-1}$ = 0.48 or if F is greater than or equal to $F_{\alpha/2,n_1-1,n_2-1}$ = 2.802, where α = 0.05. Therefore, do not reject the null hypothesis of equal variances at a significance level α = 0.05. P-value = 0.7445. Use the pooled procedure with ν = 109 degrees of freedom. T = 0.541. Reject H_o if T is greater than or equal to $t_{\nu,\alpha}$ = -2.36. Therefore, do not reject the null hypothesis at a significance level α = 0.01. P-value = 0.2948. The level $1-\alpha$ = 0.99 CI is (-0.05, 0.076).

Q51 [Answer]: F = 0.584. Reject $H_o : \sigma_1^2 = \sigma_2^2$ if F is less than or equal to $F_{1-\alpha/2,n_1-1,n_2-1}$ = 0.607 or if F is greater than or equal to $F_{\alpha/2,n_1-1,n_2-1}$ = 1.719, where α = 0.05. Therefore, reject the null hypothesis of equal variances at a significance level α = 0.05. P-value = 0.03437. Use Welch's procedure with ν = 71 degrees of freedom. T = -4.54. Reject H_o if T is less than or equal to $-t_{\nu,\alpha}$ = -1.67. Therefore, reject the null hypothesis at a significance level α = 0.05. P-value = 4.154e-05. The level $1-\alpha$ = 0.95 CI is (-0.855, -0.303).

Q52 [Answer]: Z = -2.12. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2}$ = 1.645.

Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.03426. The level $1 - \alpha = 0.95$ CI is (-3.16, -0.122).

Q53 [Answer]: $F = 1.077$. Reject $H_o : \sigma_1^2 = \sigma_2^2$ if F is less than or equal to $F_{1-\alpha/2,n_1-1,n_2-1} = 0.639$ or if F is greater than or equal to $F_{\alpha/2,n_1-1,n_2-1} = 1.541$, where $\alpha = 0.05$. Therefore, do not reject the null hypothesis of equal variances at a significance level $\alpha = 0.05$. P-value = 0.7322. Use the pooled procedure with $\nu = 165$ degrees of freedom. T = -0.945. Reject H_o if $|T|$ is greater than or equal to $t_{\nu,\alpha/2} = 1.65$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.1$. P-value = 0.3458. The level $1 - \alpha = 0.9$ CI is (-0.055, 0.015).

Q54 [Answer]: $Z = 4.315$. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2}$ = 1.645. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 1.593e-05. The level $1 - \alpha = 0.95$ CI is (0.389, 1.036).

Q55 [Answer]: Z = -1.22. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2} = 2.326$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.01$. P-value = 0.2215. The level $1 - \alpha = 0.99$ CI is (-1.24, 0.443).

Q56 [Answer]: $F = 0.462$. Reject $H_o : \sigma_1^2 = \sigma_2^2$ if F is less than or equal to $F_{1-\alpha/2,n_1-1,n_2-1} = 0.419$ or if F is greater than or equal to $F_{\alpha/2,n_1-1,n_2-1} = 3.771$, where $\alpha = 0.05$. Therefore, do not reject the null hypothesis of equal variances at a significance level $\alpha = 0.05$. P-value = 0.08194. Use the pooled procedure with $\nu = 76$ degrees of freedom. $T = 2.762$. Reject H_o if T is less than or equal to $-t_{\nu,\alpha}$ = -1.67. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.9964. The level $1 - \alpha = 0.95$ CI is (0.372, 2.292).

Q57 [Answer]: $F = 0.698$. Reject $H_o : \sigma_1^2 = \sigma_2^2$ if F is less than or equal to $F_{1-\alpha/2,n_1-1,n_2-1} = 0.582$ or if F is greater than or equal to $F_{\alpha/2,n_1-1,n_2-1} = 1.637$, where $\alpha = 0.05$. Therefore, do not reject the null hypothesis of equal variances at a significance level $\alpha = 0.05$. P-value = 0.1904. Use the pooled procedure with $\nu = 135$ degrees of freedom. T = -2.97. Reject H_o if $|T|$ is greater than or equal to $t_{\nu,\alpha/2}$ = 1.98. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.003512. The level $1 - \alpha = 0.95$ CI is (-0.768, -0.154).

Q58 [Answer]: $Z = 3.06$. Reject H_o if Z is greater than or equal to $z_\alpha = 1.282$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.1$. P-value = 0.001105. The level $1 - \alpha = 0.9$ CI is (0.232, 0.772).

Q59 [Answer]: $F = 1.036$. Reject $H_o : \sigma_1^2 = \sigma_2^2$ if F is less than or equal to $F_{1-\alpha/2,n_1-1,n_2-1} = 0.562$ or if F is greater than or equal to $F_{\alpha/2,n_1-1,n_2-1} = 1.894$, where $\alpha = 0.05$. Therefore, do not reject the null hypothesis of equal variances at a significance level $\alpha = 0.05$. P-value = 0.9364. Use the pooled procedure with $\nu = 97$ degrees of freedom. T = -0.731. Reject H_o if $|T|$ is greater than or equal to $t_{\nu,\alpha/2} = 1.98$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.4667. The level $1 - \alpha = 0.95$ CI is (-0.725, 0.335).

Q60 [Answer]: Z = -3.27. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2} = 2.326$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.01$. P-value = 0.001075. The level $1 - \alpha = 0.99$ CI is (-3.27, -0.388).

Q61 [Answer]: $F = 1.77$. Reject $H_o : \sigma_1^2 = \sigma_2^2$ if F is less than or equal to

$F_{1-\alpha/2,n_1-1,n_2-1} = 0.657$ or if F is greater than or equal to $F_{\alpha/2,n_1-1,n_2-1} = 1.533$, where $\alpha = 0.05$. Therefore, reject the null hypothesis of equal variances at a significance level $\alpha = 0.05$. P-value = 0.009099. Use Welch's procedure with $\nu = 172$ degrees of freedom. T = -2.76. Reject H_o if $|T|$ is greater than or equal to $t_{\nu,\alpha/2} = 1.97$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.005266. The level $1 - \alpha = 0.95$ CI is (-1.43, -0.254).

Q62 [Answer]: $F = 0.434$. Reject $H_o : \sigma_1^2 = \sigma_2^2$ if F is less than or equal to $F_{1-\alpha/2,n_1-1,n_2-1} = 0.617$ or if F is greater than or equal to $F_{\alpha/2,n_1-1,n_2-1} = 1.596$, where $\alpha = 0.05$. Therefore, reject the null hypothesis of equal variances at a significance level $\alpha = 0.05$. P-value = 0.0008429. Use Welch's procedure with $\nu = 138$ degrees of freedom. $T = 5.53$. Reject H_o if T is greater than or equal to $t_{\nu,\alpha} = 1.66$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 1.878e-08. The level $1 - \alpha = 0.95$ CI is (1.196, 2.424).

Q63 [Answer]: $F = 0.749$. Reject $H_o : \sigma_1^2 = \sigma_2^2$ if F is less than or equal to $F_{1-\alpha/2,n_1-1,n_2-1} = 0.51$ or if F is greater than or equal to $F_{\alpha/2,n_1-1,n_2-1} = 1.854$, where $\alpha = 0.05$. Therefore, do not reject the null hypothesis of equal variances at a significance level $\alpha = 0.05$. P-value = 0.3987. Use the pooled procedure with $\nu = 82$ degrees of freedom. $T = 1.539$. Reject H_o if T is greater than or equal to $t_{\nu,\alpha} = 1.29$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.1$. P-value = 0.06379. The level $1 - \alpha = 0.9$ CI is (-0.0544, 1.4).

Q64 [Answer]: $Z = 0.709$. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2} = 1.645$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.4784. The level $1 - \alpha = 0.95$ CI is (-0.311, 0.663).

Q65 [Answer]: $F = 0.45$. Reject $H_o : \sigma_1^2 = \sigma_2^2$ if F is less than or equal to $F_{1-\alpha/2,n_1-1,n_2-1} = 0.638$ or if F is greater than or equal to $F_{\alpha/2,n_1-1,n_2-1} = 1.591$, where $\alpha = 0.05$. Therefore, reject the null hypothesis of equal variances at a significance level $\alpha = 0.05$. P-value = 0.0005273. Use Welch's procedure with $\nu = 109$ degrees of freedom. $T = 4.191$. Reject H_o if $|T|$ is greater than or equal to $t_{\nu,\alpha/2} = 2.62$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.01$. P-value = 0.0001208. The level $1 - \alpha = 0.99$ CI is (0.488, 2.358).

Q66 [Answer]: $Z = 0.234$. Reject H_o if Z is greater than or equal to $z_\alpha = 1.645$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.4074. The level $1 - \alpha = 0.95$ CI is (-0.965, 1.227).

Q67 [Answer]: $Z = 1.519$. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2} = 1.645$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.1288. The level $1 - \alpha = 0.95$ CI is (-0.176, 1.39).

Q68 [Answer]: $Z = 1.609$. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2} = 1.282$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.1$. P-value = 0.1077. The level $1 - \alpha = 0.9$ CI is (-0.00617, 0.556).

Q69 [Answer]: $\bar{X}_1$ = -0.075, $\bar{X}_2 = 2.29$, $S_D = 0.524$. T = -12.8. Reject H_o if $|T|$ is greater than or equal to $t_{n-1,\alpha/2} = 2.365$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 4.173e-06. The level $1 - \alpha = 0.95$ CI is (-2.8, -1.93).

Q70 [Answer]: $\bar{X}_1$ = 18.912, $\bar{X}_2$ = 14.662, S_D = 0.38. T = 35.338. Reject H_o if $|T|$ is greater than or equal to $t_{n-1,\alpha/2}$ = 2.262. Therefore, reject the null hypothesis at a significance level α = 0.05. P-value = 5.753e-11. The level $1 - \alpha$ = 0.95 CI is (3.978, 4.522).

Q71 [Answer]: $\bar{X}_1$ = 0.441, $\bar{X}_2$ = 0.948, S_D = 1.792. T = -0.633. Reject H_o if $|T|$ is greater than or equal to $t_{n-1,\alpha/2}$ = 2.776. Therefore, do not reject the null hypothesis at a significance level α = 0.05. P-value = 0.5611. The level $1 - \alpha$ = 0.95 CI is (-2.73, 1.718).

Q72 [Answer]: $\bar{X}_1$ = 21.009, $\bar{X}_2$ = 27.345, S_D = 2.023. T = -8.86. Reject H_o if $|T|$ is greater than or equal to $t_{n-1,\alpha/2}$ = 3.499. Therefore, reject the null hypothesis at a significance level α = 0.01. P-value = 4.729e-05. The level $1 - \alpha$ = 0.99 CI is (-8.84, -3.83).

Q73 [Answer]: $\bar{X}_1$ = 5.876, $\bar{X}_2$ = 6.256, S_D = 0.318. T = -3.38. Reject H_o if $|T|$ is greater than or equal to $t_{n-1,\alpha/2}$ = 1.895. Therefore, reject the null hypothesis at a significance level α = 0.1. P-value = 0.01178. The level $1 - \alpha$ = 0.9 CI is (-0.593, -0.167).

Q74 [Answer]: $\bar{X}_1$ = 12.369, $\bar{X}_2$ = 12.383, S_D = 0.814. T = -0.045. Reject H_o if $|T|$ is greater than or equal to $t_{n-1,\alpha/2}$ = 2.447. Therefore, do not reject the null hypothesis at a significance level α = 0.05. P-value = 0.9655. The level $1 - \alpha$ = 0.95 CI is (-0.767, 0.739).

Q75 [Answer]: $\bar{X}_1$ = -0.0438, $\bar{X}_2$ = -1.02, S_D = 1.081. T = 2.014. Reject H_o if $|T|$ is greater than or equal to $t_{n-1,\alpha/2}$ = 2.776. Therefore, do not reject the null hypothesis at a significance level α = 0.05. P-value = 0.1143. The level $1 - \alpha$ = 0.95 CI is (-0.369, 2.316).

Q76 [Answer]: $\bar{X}_1$ = 11.184, $\bar{X}_2$ = 7.935, S_D = 1.951. T = 5.264. Reject H_o if $|T|$ is greater than or equal to $t_{n-1,\alpha/2}$ = 2.262. Therefore, reject the null hypothesis at a significance level α = 0.05. P-value = 0.0005181. The level $1 - \alpha$ = 0.95 CI is (1.852, 4.644).

Q77 [Answer]: $\bar{X}_1$ = 7.06, $\bar{X}_2$ = 6.986, S_D = 0.441. T = 0.446. Reject H_o if $|T|$ is greater than or equal to $t_{n-1,\alpha/2}$ = 3.707. Therefore, do not reject the null hypothesis at a significance level α = 0.01. P-value = 0.6711. The level $1 - \alpha$ = 0.99 CI is (-0.544, 0.693).

Q78 [Answer]: $\bar{X}_1$ = 5.624, $\bar{X}_2$ = 6.359, S_D = 0.375. T = -4.38. Reject H_o if $|T|$ is greater than or equal to $t_{n-1,\alpha/2}$ = 2.132. Therefore, reject the null hypothesis at a significance level α = 0.1. P-value = 0.0119. The level $1 - \alpha$ = 0.9 CI is (-1.09, -0.377).

Q79 [Answer]: (0.281,0.494) or 0.388 $\pm$ 0.107

Q80 [Answer]: (0.308,0.404) or 0.356 $\pm$ 0.0478

Q81 [Answer]: (0.426,0.54) or 0.483 $\pm$ 0.0573

Q82 [Answer]: (0.219,0.424) or 0.321 $\pm$ 0.103

Q83 [Answer]: (0.18,0.3) or 0.24 $\pm$ 0.06

Q84 [Answer]: (0.247,0.335) or 0.291 $\pm$ 0.044

Q85 [Answer]: (0.57,0.839) or 0.705 $\pm$ 0.135

Q86 [Answer]: (0.203,0.451) or 0.327 $\pm$ 0.124

Q87 [Answer]: (0.181,0.311) or 0.246 $\pm$ 0.0652

Q88 [Answer]: (-0.0617,0.415) or 0.176 $\pm$ 0.238

Q89 [Answer]: $\hat{p}$ = 0.395, Z = -4.33. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2}$ = 1.96. Therefore, reject the null hypothesis at a significance level α = 0.05. P-value = 1.468e-05. The level $1 - \alpha = 0.95$ CI is (0.324, 0.465). Applying the continuity correction gives P-value = 2.048e-05 and the exact binomial distribution gives P-value = 2.159e-05.

Q90 [Answer]: $\hat{p}$ = 0.316, Z = -3.46. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2}$ = 1.96. Therefore, reject the null hypothesis at a significance level α = 0.05. P-value = 0.0005395. The level $1 - \alpha = 0.95$ CI is (0.266, 0.365). Applying the continuity correction gives P-value = 0.0006614 and the exact binomial distribution gives P-value = 0.0005568.

Q91 [Answer]: $\hat{p}$ = 0.429, Z = 2.545. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2}$ = 1.96. Therefore, reject the null hypothesis at a significance level α = 0.05. P-value = 0.01092. The level $1 - \alpha = 0.95$ CI is (0.373, 0.484). Applying the continuity correction gives P-value = 0.01292 and the exact binomial distribution gives P-value = 0.01385.

Q92 [Answer]: $\hat{p}$ = 0.385, Z = -5.82. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2}$ = 2.576. Therefore, reject the null hypothesis at a significance level α = 0.01. P-value = 5.85e-09. The level $1 - \alpha = 0.99$ CI is (0.3, 0.469). Applying the continuity correction gives P-value = 8.772e-09 and the exact binomial distribution gives P-value = 1.132e-08.

Q93 [Answer]: $\hat{p}$ = 0.391, Z = 1.855. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2}$ = 1.645. Therefore, reject the null hypothesis at a significance level α = 0.1. P-value = 0.06354. The level $1 - \alpha = 0.9$ CI is (0.337, 0.445). Applying the continuity correction gives P-value = 0.07445 and the exact binomial distribution gives P-value = 0.07699.

Q94 [Answer]: $\hat{p}$ = 0.455, Z = 1.412. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2}$ = 1.96. Therefore, do not reject the null hypothesis at a significance level α = 0.05. P-value = 0.158. The level $1 - \alpha = 0.95$ CI is (0.406, 0.505). Applying the continuity correction gives P-value = 0.1736 and the exact binomial distribution gives P-value = 0.1742.

Q95 [Answer]: $\hat{p}$ = 0.669, Z = -7.42. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2}$ = 1.96. Therefore, reject the null hypothesis at a significance level α = 0.05. P-value = 1.206e-13. The level $1 - \alpha = 0.95$ CI is (0.616, 0.722). Applying the continuity correction gives P-value = 2.149e-13 and the exact binomial distribution gives P-value = 1.99e-11.

Q96 [Answer]: $\hat{p}$ = 0.306, Z = 2.785. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2}$ = 1.96. Therefore, reject the null hypothesis at a significance level α = 0.05. P-value = 0.005357. The level $1 - \alpha = 0.95$ CI is (0.255, 0.358). Applying the continuity correction gives P-value = 0.006565 and the exact binomial distribution gives P-value = 0.00796.

Q97 [Answer]: $\hat{p}$ = 0.305, Z = 1.015. Reject H_o if $|Z|$ is greater than or equal to

$z_{\alpha/2} = 2.576$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.01$. P-value = 0.3101. The level $1 - \alpha = 0.99$ CI is (0.245, 0.365). Applying the continuity correction gives P-value = 0.3377 and the exact binomial distribution gives P-value = 0.3373.

Q98 [Answer]: $\hat{p} = 0.612$, Z = -3.38. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2} = 1.645$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.1$. P-value = 0.0007365. The level $1 - \alpha = 0.9$ CI is (0.553, 0.67). Applying the continuity correction gives P-value = 0.0009869 and the exact binomial distribution gives P-value = 0.001383.

Q99 [Answer]: (-0.188,-0.0311) or -0.11 $\pm$ 0.0785

Q100 [Answer]: (-0.105,0.0499) or -0.0277 $\pm$ 0.0776

Q101 [Answer]: (-0.364,-0.0182) or -0.191 $\pm$ 0.173

Q102 [Answer]: (-0.605,0.402) or -0.102 $\pm$ 0.504

Q103 [Answer]: (-0.249,-0.122) or -0.186 $\pm$ 0.0635

Q104 [Answer]: (-0.198,0.202) or 0.00193 $\pm$ 0.2

Q105 [Answer]: (-0.0274,0.127) or 0.0497 $\pm$ 0.0771

Q106 [Answer]: (-0.128,0.0763) or -0.026 $\pm$ 0.102

Q107 [Answer]: (0.00146,0.166) or 0.0839 $\pm$ 0.0825

Q108 [Answer]: (0.131,0.656) or 0.394 $\pm$ 0.263

Q109 [Answer]: Z = 3.641. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2} = 1.96$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.0002718. The level $1 - \alpha = 0.95$ CI is (0.055, 0.18).

Q110 [Answer]: Z = -3.66. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2} = 1.96$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.0002478. The level $1 - \alpha = 0.95$ CI is (-0.172, -0.0533).

Q111 [Answer]: Z = 0.344. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2} = 1.96$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.7309. The level $1 - \alpha = 0.95$ CI is (-0.0508, 0.0726).

Q112 [Answer]: Z = -2.35. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2} = 1.645$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.1$. P-value = 0.01889. The level $1 - \alpha = 0.9$ CI is (-0.145, -0.0236).

Q113 [Answer]: Z = -1.17. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2} = 2.576$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.01$. P-value = 0.241. The level $1 - \alpha = 0.99$ CI is (-0.109, 0.0414).

Q114 [Answer]: Z = 2. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2} = 1.96$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.04548. The level $1 - \alpha = 0.95$ CI is (0.0126, 0.198).

Q115 [Answer]: Z = -2.89. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2} = 1.96$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.003837. The level $1 - \alpha = 0.95$ CI is (-0.216, -0.0473).

Q116 [Answer]: Z = 0.602. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2} = 1.96$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.5473. The level $1 - \alpha = 0.95$ CI is (-0.22, 0.411).

Q117 [Answer]: Z = -4.81. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2} = 1.645$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.1$. P-value = 1.497e-06. The level $1-\alpha = 0.9$ CI is (-0.22, -0.105).

Q118 [Answer]: $Z = 0.0896$. Reject H_o if $|Z|$ is greater than or equal to $z_{\alpha/2} = 2.576$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.01$. P-value = 0.9286. The level $1-\alpha = 0.99$ CI is (-0.115, 0.123).

Q119 [Answer]: Without Yate's correction: $X^2 = 11.27$. Reject H_o if X^2 is greater than or equal to $\chi^2_{k-1,\alpha} = 7.815$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.0103. With Yate's correction: $X^2 = 8.213$. Reject H_o if X^2 is greater than or equal to $\chi^2_{k-1,\alpha} = 7.815$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.0418.

	1	2	3	4	Totals
Observed counts O_i	0.00	6.00	2.00	10.00	18.00
Expected counts E_i	3.06	3.06	5.94	5.94	18.00
$(O_i - E_i)^2/E_i$	3.06	2.82	2.61	2.78	11.27
$(\lvert O_i - E_i\rvert - 0.5)^2/E_i$	2.14	1.95	1.99	2.14	8.21

Q120 [Answer]: Without Yate's correction: $X^2 = 3.468$. Reject H_o if X^2 is greater than or equal to $\chi^2_{k-1,\alpha} = 6.251$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.1$. P-value = 0.325. With Yate's correction: $X^2 = 3.113$. Reject H_o if X^2 is greater than or equal to $\chi^2_{k-1,\alpha} = 6.251$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.1$. P-value = 0.3745.

	1	2	3	4	Totals
Observed counts O_i	295.00	99.00	99.00	44.00	537.00
Expected counts E_i	302.06	100.69	100.69	33.56	537.00
$(O_i - E_i)^2/E_i$	0.17	0.03	0.03	3.25	3.47
$(\lvert O_i - E_i\rvert - 0.5)^2/E_i$	0.14	0.01	0.01	2.94	3.11

Q121 [Answer]: Without Yate's correction: $X^2 = 3.723$. Reject H_o if X^2 is greater than or equal to $\chi^2_{k-1,\alpha} = 11.07$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.5899. With Yate's correction: $X^2 = 3.171$. Reject H_o if X^2 is greater than or equal to $\chi^2_{k-1,\alpha} = 11.07$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.6736.

	1	2	3	4	5	6	Totals
Observed counts O_i	43.00	40.00	36.00	41.00	37.00	41.00	238.00
Expected counts E_i	47.60	39.67	39.67	39.67	39.67	31.73	238.02
$(O_i - E_i)^2/E_i$	0.44	0.00	0.34	0.04	0.18	2.71	3.72
$(\lvert O_i - E_i\rvert - 0.5)^2/E_i$	0.35	0.00	0.25	0.02	0.12	2.43	3.17

Q122 [Answer]: Without Yate's correction: $X^2 = 4.58$. Reject H_o if X^2 is greater than or equal to $\chi^2_{k-1,\alpha} = 5.991$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.1013. With Yate's correction: $X^2 = 4.279$. Reject H_o if X^2 is greater than or equal to $\chi^2_{k-1,\alpha} = 5.991$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.1177.

	1	2	3	Totals
Observed counts O_i	125.00	201.00	98.00	424.00
Expected counts E_i	106.00	212.00	106.00	424.00
$(O_i - E_i)^2/E_i$	3.41	0.57	0.60	4.58
$(\lvert O_i - E_i\rvert - 0.5)^2/E_i$	3.23	0.52	0.53	4.28

Q123 [Answer]: Without Yate's correction: $X^2 = 5.918$. Reject H_o if X^2 is greater than or equal to $\chi^2_{k-1,\alpha} = 11.345$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.01$. P-value = 0.1157. With Yate's correction: $X^2 = 5.383$. Reject H_o if X^2 is greater than or equal to $\chi^2_{k-1,\alpha} = 11.345$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.01$. P-value = 0.1458.

	1	2	3	4	Totals
Observed counts O_i	33.00	47.00	56.00	47.00	183.00
Expected counts E_i	45.75	45.75	45.75	45.75	183.00
$(O_i - E_i)^2/E_i$	3.55	0.03	2.30	0.03	5.92
$(\lvert O_i - E_i\rvert - 0.5)^2/E_i$	3.28	0.01	2.08	0.01	5.38

Q124 [Answer]: Without Yate's correction: $X^2 = 18.632$. Reject H_o if X^2 is greater than or equal to $\chi^2_{(n_r-1)(n_c-1),\alpha} = 12.592$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.004831. With Yate's correction: $X^2 = 16.354$. Reject H_o if X^2 is greater than or equal to $\chi^2_{k-1,\alpha} = 12.592$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.01198.

	1	2	3	4	Totals
1	10.00	18.00	30.00	38.00	96.00
2	21.00	38.00	61.00	78.00	198.00
3	28.00	51.00	81.00	104.00	264.00
Totals	59.00	107.00	172.00	220.00	558.00

Table 6: Expected counts $E_{i,j}$

	1	2	3	4	Totals
1	5.00	1.00	1.00	0.00	7.00
2	5.00	0.00	0.00	3.00	8.00
3	0.00	1.00	0.00	3.00	4.00
Totals	10.00	2.00	1.00	6.00	19.00

Table 7: X^2 statistic terms $(O_i - E_i)^2/E_i$

	1	2	3	4	Totals
1	4.00	1.00	1.00	0.00	6.00
2	4.00	0.00	0.00	2.00	6.00
3	0.00	1.00	0.00	2.00	3.00
Totals	8.00	2.00	1.00	4.00	15.00

Table 8: X^2 statistic terms (with Yates's correction) $(|O_i - E_i| - 0.5)^2/E_i$

Q125 [Answer]: Without Yate's correction: $X^2 = 6.983$. Reject H_o if X^2 is greater than or equal to $\chi^2_{(n_r-1)(n_c-1),\alpha} = 2.706$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.1$. P-value = 0.008228. With Yate's correction: $X^2 = 5.777$. Reject H_o if X^2 is greater than or equal to $\chi^2_{k-1,\alpha} = 2.706$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.1$. P-value = 0.01624.

	1	2	Totals
1	16.00	30.00	46.00
2	11.00	23.00	34.00
Totals	27.00	53.00	80.00

Table 9: Expected counts $E_{i,j}$

	1	2	Totals
1	2.00	1.00	3.00
2	3.00	1.00	4.00
Totals	5.00	2.00	7.00

Table 10: X^2 statistic terms $(O_i - E_i)^2/E_i$

	1	2	Totals
1	2.00	1.00	3.00
2	2.00	1.00	3.00
Totals	4.00	2.00	6.00

Table 11: X^2 statistic terms (with Yates's correction) $(|O_i - E_i| - 0.5)^2/E_i$

Q126 [Answer]: Without Yate's correction: $X^2 = 37.492$. Reject H_o if X^2 is greater than or equal to $\chi^2_{(n_r-1)(n_c-1),\alpha} = 12.592$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 1.411e-06. With Yate's correction: $X^2 = 33.262$. Reject H_o if X^2 is greater than or equal to $\chi^2_{k-1,\alpha} = 12.592$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 9.335e-06.

	1	2	3	4	Totals
1	10.00	16.00	17.00	48.00	91.00
2	11.00	18.00	19.00	53.00	101.00
3	7.00	11.00	12.00	32.00	62.00
Totals	28.00	45.00	48.00	133.00	254.00

Table 12: Expected counts $E_{i,j}$

	1	2	3	4	Totals
1	3.00	1.00	0.00	3.00	7.00
2	2.00	0.00	0.00	1.00	3.00
3	14.00	5.00	0.00	9.00	28.00
Totals	19.00	6.00	0.00	13.00	38.00

Table 13: X^2 statistic terms $(O_i - E_i)^2/E_i$

	1	2	3	4	Totals
1	2.00	1.00	0.00	2.00	5.00
2	1.00	0.00	0.00	1.00	2.00
3	13.00	4.00	0.00	9.00	26.00
Totals	16.00	5.00	0.00	12.00	33.00

Table 14: X^2 statistic terms (with Yates's correction) $(|O_i - E_i| - 0.5)^2/E_i$

Q127 [Answer]: Without Yate's correction: $X^2 = 24.65$. Reject H_o if X^2 is greater than or equal to $\chi^2_{(n_r-1)(n_c-1),\alpha} = 5.991$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 4.44e-06. With Yate's correction: $X^2 = 23.193$. Reject H_o if X^2 is greater than or equal to $\chi^2_{k-1,\alpha} = 5.991$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 9.198e-06.

	1	2	3	Totals
1	59.00	63.00	95.00	217.00
2	43.00	47.00	71.00	161.00
Totals	102.00	110.00	166.00	378.00

Table 15: Expected counts $E_{i,j}$

	1	2	3	Totals
1	4.00	1.00	6.00	11.00
2	5.00	2.00	8.00	15.00
Totals	9.00	3.00	14.00	26.00

Table 16: X^2 statistic terms $(O_i - E_i)^2/E_i$

	1	2	3	Totals
1	3.00	1.00	5.00	9.00
2	4.00	1.00	7.00	12.00
Totals	7.00	2.00	12.00	21.00

Table 17: X^2 statistic terms (with Yates's correction) $(|O_i - E_i| - 0.5)^2/E_i$

Q128 [Answer]: Without Yate's correction: $X^2 = 4.744$. Reject H_o if X^2 is greater than or equal to $\chi^2_{(n_r-1)(n_c-1),\alpha} = 6.635$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.01$. P-value = 0.0294. With Yate's correction: $X^2 = 3.704$. Reject H_o if X^2 is greater than or equal to $\chi^2_{k-1,\alpha} = 6.635$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.01$. P-value = 0.05429.

	1	2	Totals
1	30.00	6.00	36.00
2	88.00	19.00	107.00
Totals	118.00	25.00	143.00

Table 18: Expected counts $E_{i,j}$

	1	2	Totals
1	1.00	3.00	4.00
2	0.00	1.00	1.00
Totals	1.00	4.00	5.00

Table 19: X^2 statistic terms $(O_i - E_i)^2/E_i$

	1	2	Totals
1	0.00	2.00	2.00
2	0.00	1.00	1.00
Totals	0.00	3.00	3.00

Table 20: X^2 statistic terms (with Yates's correction) $(|O_i - E_i| - 0.5)^2/E_i$

Q129 [Answer]: The estimate of the OR is $\hat{OR} = 0.0923$. The CI is (-3.07, -1.69) or

-2.38 $\pm$ 0.689. The CI does not contain 0, so reject the null hypothesis at a significance level $\alpha = 0.05$

Q130 [Answer]: The estimate of the OR is $\hat{OR} = 0.275$. The CI is (-2.54, -0.0434) or -1.29 $\pm$ 1.247. The CI does not contain 0, so reject the null hypothesis at a significance level $\alpha = 0.01$

Q131 [Answer]: The estimate of the OR is $\hat{OR} = 1.103$. The CI is (-0.848, 1.044) or 0.0979 $\pm$ 0.946. The CI contains 0, so do not reject the null hypothesis at a significance level $\alpha = 0.05$

Q132 [Answer]: The estimate of the OR is $\hat{OR} = 0.584$. The CI is (-0.937, -0.138) or -0.537 $\pm$ 0.4. The CI does not contain 0, so reject the null hypothesis at a significance level $\alpha = 0.1$

Q133 [Answer]: The estimate of the OR is $\hat{OR} = 0.846$. The CI is (-0.452, 0.117) or -0.167 $\pm$ 0.285. The CI contains 0, so reject the null hypothesis at a significance level $\alpha = 0.05$

Q134 [Answer]: The estimate of the OR is $\hat{OR} = 1.088$. The CI is (-0.242, 0.411) or 0.0843 $\pm$ 0.326. The CI contains 0, so do not reject the null hypothesis at a significance level $\alpha = 0.05$

Q135 [Answer]: The estimate of the OR is $\hat{OR} = 1.009$. The CI is (-0.495, 0.513) or 0.00873 $\pm$ 0.504. The CI contains 0, so do not reject the null hypothesis at a significance level $\alpha = 0.01$

Q137 [Answer]: $F = 4.954$. Reject H_o if F is greater than or equal to $F_{k-1,n-k,\alpha} = 3.885$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value = 0.027.

	SS	DF	MS	F	Pval
Treatment	126.16	2.00	63.08	4.95	0.03
Error	152.79	12.00	12.73		
Total	278.95	14.00			

Table 21: ANOVA Table

	Treatment 1	Treatment 2	Difference	Margin of Error	LB	UB
Comp 1	1.00	3.00	-6.16	5.78	-11.94	-0.39
Comp 2	2.00	3.00	-6.14	5.78	-11.92	-0.36

Table 22: Multiple comparisons (Bonferroni procedure)

	Treatment 1	Treatment 2	Difference	Margin of Error	LB	UB
Comp 1	1.00	2.00	-0.02	6.02	-6.05	6.00
Comp 2	1.00	3.00	-6.16	6.02	-12.19	-0.14
Comp 3	2.00	3.00	-6.14	6.02	-12.16	-0.12

Table 23: Multiple comparisons (Tukey's procedure)

Q138 [Answer]: $F = 0.352$. Reject H_o if F is greater than or equal to $F_{k-1,n-k,\alpha} = 3.344$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$. P-value $= 0.7885$.

	SS	DF	MS	F	Pval
Treatment	36.65	3.00	12.22	0.35	0.79
Error	486.14	14.00	34.72		
Total	522.78	17.00			

Table 24: ANOVA Table

	Treatment 1	Treatment 2	Difference	Margin of Error	LB	UB
Comp 1	1.00	4.00	-2.66	9.55	-12.20	6.89
Comp 2	2.00	3.00	2.41	10.80	-8.39	13.21

Table 25: Multiple comparisons (Bonferroni procedure)

	Treatment 1	Treatment 2	Difference	Margin of Error	LB	UB
Comp 1	1.00	4.00	-2.66	11.06	-13.71	8.40
Comp 2	2.00	3.00	2.41	12.51	-10.10	14.92

Table 26: Multiple comparisons (Tukey's procedure)

Q139 [Answer]: $F = 5.284$. Reject H_o if F is greater than or equal to $F_{k-1,n-k,\alpha} = 2.668$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.1$. P-value $= 0.0173$.

	SS	DF	MS	F	Pval
Treatment	115.31	2.00	57.65	5.28	0.02
Error	174.57	16.00	10.91		
Total	289.88	18.00			

Table 27: ANOVA Table

	Treatment 1	Treatment 2	Difference	Margin of Error	LB	UB
Comp 1	1.00	2.00	-2.94	4.37	-7.30	1.43
Comp 2	1.00	3.00	-6.28	4.78	-11.06	-1.49

Table 28: Multiple comparisons (Bonferroni procedure)

	Treatment 1	Treatment 2	Difference	Margin of Error	LB	UB
Comp 1	1.00	2.00	-2.94	4.56	-7.49	1.62
Comp 2	1.00	3.00	-6.28	4.99	-11.27	-1.28

Table 29: Multiple comparisons (Tukey's procedure)

Q140 [Answer]: $F = 0.373$. Reject H_o if F is greater than or equal to $F_{k-1,n-k,\alpha} = 5.953$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.01$. P-value $= 0.774$.

	SS	DF	MS	F	Pval
Treatment	4.79	3.00	1.60	0.37	0.77
Error	51.36	12.00	4.28		
Total	56.15	15.00			

Table 30: ANOVA Table

	Treatment 1	Treatment 2	Difference	Margin of Error	LB	UB
Comp 1	2.00	1.00	0.60	4.07	-3.46	4.67
Comp 2	2.00	3.00	-0.66	4.07	-4.73	3.40
Comp 3	2.00	4.00	0.71	4.07	-3.36	4.77

Table 31: Multiple comparisons (Bonferroni procedure)

	Treatment 1	Treatment 2	Difference	Margin of Error	LB	UB
Comp 1	1.00	2.00	-0.60	4.34	-4.95	3.74
Comp 2	1.00	3.00	-1.26	4.34	-5.61	3.08
Comp 3	1.00	4.00	0.11	4.34	-4.24	4.45
Comp 4	2.00	3.00	-0.66	4.34	-5.01	3.68
Comp 5	2.00	4.00	0.71	4.34	-3.64	5.05
Comp 6	3.00	4.00	1.37	4.34	-2.97	5.71

Table 32: Multiple comparisons (Tukey's procedure)

Q141 [Answer]: $F = 9.194$. Reject H_o if F is greater than or equal to $F_{k-1,n-k,\alpha} = 3.682$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. P-value $= 0.002476$.

	SS	DF	MS	F	Pval
Treatment	323.33	2.00	161.67	9.19	0.00
Error	263.75	15.00	17.58		
Total	587.08	17.00			

Table 33: ANOVA Table

	Treatment 1	Treatment 2	Difference	Margin of Error	LB	UB
Comp 1	1.00	2.00	9.74	6.52	3.21	16.26
Comp 2	1.00	3.00	1.75	6.52	-4.77	8.27
Comp 3	2.00	3.00	-7.99	6.52	-14.51	-1.47

Table 34: Multiple comparisons (Bonferroni procedure)

	Treatment 1	Treatment 2	Difference	Margin of Error	LB	UB
Comp 1	1.00	2.00	9.74	6.29	3.45	16.02
Comp 2	1.00	3.00	1.75	6.29	-4.54	8.03
Comp 3	2.00	3.00	-7.99	6.29	-14.28	-1.70

Table 35: Multiple comparisons (Tukey's procedure)

Q142 [Answer]: The sample median of the differences is $\tilde{D}$ = 0.4. After excluding ties there are $X = 5$ positive differences among $n' = 5$ pairs. We obtain P-value = 0.03125. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$.

Q143 [Answer]: The sample median of the differences is $\tilde{D}$ = 0. After excluding ties there are $X = 3$ positive differences among $n' = 7$ pairs. We obtain P-value = 1. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$.

Q144 [Answer]: The sample median of the differences is $\tilde{D}$ = -0.1. After excluding ties there are $X = 1$ positive differences among $n' = 7$ pairs. We obtain P-value = 0.125. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$.

Q145 [Answer]: The sample median of the differences is $\tilde{D}$ = 1.3. After excluding ties there are $X = 5$ positive differences among $n' = 6$ pairs. We obtain P-value = 0.2188. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.01$.

Q146 [Answer]: The sample median of the differences is $\tilde{D}$ = 0.15. After excluding ties there are $X = 5$ positive differences among $n' = 9$ pairs. We obtain P-value = 1. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.1$.

Q147 [Answer]: The sample median of the differences is $\tilde{D}$ = -0.9. After excluding ties there are $X = 2$ positive differences among $n' = 7$ pairs. We obtain P-value = 0.4531. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$.

Q148 [Answer]: The sample median of the differences is $\tilde{D}$ = -4. After excluding ties there are $X = 1$ positive differences among $n' = 8$ pairs. We obtain P-value = 0.03516. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$.

Q149 [Answer]: The sample median of the differences is $\tilde{D}$ = -0.1. After excluding ties there are $X = 1$ positive differences among $n' = 4$ pairs. We obtain P-value = 0.625. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$.

Q150 [Answer]: The sample median of the differences is $\tilde{D}$ = -0.45. After excluding ties there are $X = 0$ positive differences among $n' = 6$ pairs. We obtain P-value = 0.01563. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.01$.

Q151 [Answer]: The sample median of the differences is $\tilde{D}$ = -0.1. After excluding ties there are $X = 5$ positive differences among $n' = 10$ pairs. We obtain P-value =

1.2461. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.1$.

Q152 [Answer]: The sample median of the differences is $\tilde{D}$ = -0.1. After excluding ties there are $X = 2$ positive differences among $n' = 6$ pairs. We obtain P-value = 0.6875. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$.

Q153 [Answer]: The sample median of the differences is $\tilde{D}$ = -0.7. After excluding ties there are $X = 3$ positive differences among $n' = 8$ pairs. We obtain P-value = 0.7266. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$.

Q154 [Answer]: The sample median of the differences is $\tilde{D}$ = -0.1. After excluding ties there are $X = 1$ positive differences among $n' = 6$ pairs. We obtain P-value = 0.2188. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$.

Q155 [Answer]: The sample median of the differences is $\tilde{D} = 2.85$. After excluding ties there are $X = 6$ positive differences among $n' = 6$ pairs. We obtain P-value = 0.01562. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.01$.

Q156 [Answer]: The sample median of the differences is $\tilde{D}$ = -0.1. After excluding ties there are $X = 3$ positive differences among $n' = 8$ pairs. We obtain P-value = 0.7266. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.1$.

Q157 [Answer]: The sample median of the differences is $\tilde{D} = 0.6$. After excluding ties there are $n' = 7$ pairs remaining. The negative and positive rank sums are, respectively, $T_- = 9.5$ and $T_+ = 18.5$. The mean and standard deviation of the negative or positive rank sums are $\mu_T = 14$ and $\sigma_T = 5.916$. This gives Z-score $Z = (T_+ - \mu_T)/\sigma_T = 0.761$. The continuity correction is applied as $Z_{correct} = (T_+ \pm 0.5 - \mu_T)/\sigma_T$. Using the exact sign rank distribution we obtain P-value = 0.4688. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$. Using the normal approximation gives P-value = 0.4469 without the continuity correction, and P-value = 0.499 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Rank $\|D\|$	Sign
1	2.8	1.9	0.9	3.5	+
2	6.7	8.5	-1.8	6.0	-
3	-0.8	-1.0	0.2	1.0	+
4	2.1	3.0	-0.9	3.5	-
5	1.1	0.5	0.6	2.0	+
6	7.3	6.0	1.3	5.0	+
7	-2.0	-4.0	2.0	7.0	+

Q158 [Answer]: The sample median of the differences is $\tilde{D} = 4.5$. After excluding ties there are $n' = 8$ pairs remaining. The negative and positive rank sums are, respectively, $T_- = 1$ and $T_+ = 35$. The mean and standard deviation of the negative or positive rank sums are $\mu_T = 18$ and $\sigma_T = 7.141$. This gives Z-score $Z = (T_+ - \mu_T)/\sigma_T = 2.38$. The continuity correction is applied as $Z_{correct} = (T_+ \pm 0.5 - \mu_T)/\sigma_T$. Using the exact sign rank distribution we obtain P-value = 0.01563. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. Using the normal approximation gives P-value = 0.01729 without the continuity correction, and P-value = 0.02086 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Rank $\|D\|$	Sign
1	4.8	2.9	1.9	2.0	+
2	8.3	4.0	4.3	4.0	+
3	4.8	5.3	-0.5	1.0	-
4	7.1	4.8	2.3	3.0	+
5	15.0	10.3	4.7	5.0	+
6	15.3	10.1	5.2	6.0	+
7	0.8	-5.0	5.8	8.0	+
8	3.7	-2.0	5.7	7.0	+

Q159 [Answer]: The sample median of the differences is $\tilde{D}$ = -3.4. After excluding ties there are $n' = 5$ pairs remaining. The negative and positive rank sums are, respectively, $T_- = 12$ and $T_+ = 3$. The mean and standard deviation of the negative or positive rank sums are $\mu_T = 7.5$ and $\sigma_T = 3.708$. This gives Z-score $Z = (T_+ - \mu_T)/\sigma_T =$ -1.21. The continuity correction is applied as $Z_{correct} = (T_+ \pm 0.5 - \mu_T)/\sigma_T$. Using the exact sign rank distribution we obtain P-value = 0.3125. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$. Using the normal approximation gives P-value = 0.2249 without the continuity correction, and P-value = 0.2807 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Rank $\|D\|$	Sign
1	11.4	14.8	-3.4	3.0	-
2	-2.0	-5.0	3.0	2.0	+
3	-1.0	2.7	-3.7	4.0	-
4	2.9	10.4	-7.5	5.0	-
5	3.1	0.5	2.6	1.0	+

Q160 [Answer]: The sample median of the differences is $\tilde{D} = 2.1$. After excluding ties there are $n' = 6$ pairs remaining. The negative and positive rank sums are, respectively, $T_- = 6$ and $T_+ = 15$. The mean and standard deviation of the negative or positive rank sums are $\mu_T = 10.5$ and $\sigma_T = 4.77$. This gives Z-score $Z = (T_+ - \mu_T)/\sigma_T =$ 0.943. The continuity correction is applied as $Z_{correct} = (T_+ \pm 0.5 - \mu_T)/\sigma_T$. Using the exact sign rank distribution we obtain P-value = 0.2188. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.01$. Using the normal approximation gives P-value = 0.1727 without the continuity correction, and P-value = 0.2008 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Rank $\|D\|$	Sign
1	11.2	16.8	-5.6	5.0	-
2	12.3	7.1	5.2	4.0	+
3	17.7	15.6	2.1	2.0	+
4	17.4	17.4	0.0		0
5	8.7	2.0	6.7	6.0	+
6	14.0	9.8	4.2	3.0	+
7	15.4	17.2	-1.8	1.0	-

Q161 [Answer]: The sample median of the differences is $\tilde{D} = 1.2$. After excluding ties there are $n' = 7$ pairs remaining. The negative and positive rank sums are, respectively, $T_{-} = 3$ and $T_{+} = 25$. The mean and standard deviation of the negative or positive rank sums are $\mu_T = 14$ and $\sigma_T = 5.916$. This gives Z-score $Z = (T_{+} - \mu_T)/\sigma_T = 1.859$. The continuity correction is applied as $Z_{correct} = (T_{+} \pm 0.5 - \mu_T)/\sigma_T$. Using the exact sign rank distribution we obtain P-value $= 0.03906$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.1$. Using the normal approximation gives P-value $= 0.03149$ without the continuity correction, and P-value $= 0.03796$ with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Rank $\|D\|$	Sign
1	6.0	4.3	1.7	5.0	+
2	4.1	2.3	1.8	6.0	+
3	4.7	1.9	2.8	7.0	+
4	5.7	5.3	0.4	3.0	+
5	7.0	7.2	-0.2	1.0	-
6	5.6	4.4	1.2	4.0	+
7	7.7	8.0	-0.3	2.0	-

Q162 [Answer]: The sample median of the differences is $\tilde{D} = 3.3$. After excluding ties there are $n' = 9$ pairs remaining. The negative and positive rank sums are, respectively, $T_{-} = 7$ and $T_{+} = 38$. The mean and standard deviation of the negative or positive rank sums are $\mu_T = 22.5$ and $\sigma_T = 8.441$. This gives Z-score $Z = (T_{+} - \mu_T)/\sigma_T = 1.836$. The continuity correction is applied as $Z_{correct} = (T_{+} \pm 0.5 - \mu_T)/\sigma_T$. Using the exact sign rank distribution we obtain P-value $= 0.03711$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. Using the normal approximation gives P-value $= 0.03316$ without the continuity correction, and P-value $= 0.03778$ with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Rank $\|D\|$	Sign
1	9.5	3.9	5.6	8.0	+
2	10.1	4.7	5.4	7.0	+
3	8.8	11.4	-2.6	4.0	-
4	3.3	1.2	2.1	3.0	+
5	9.0	10.7	-1.7	2.0	-
6	13.1	14.0	-0.9	1.0	-
7	12.3	9.0	3.3	5.5	+
8	12.2	5.4	6.8	9.0	+
9	8.4	5.1	3.3	5.5	+

Q163 [Answer]: The sample median of the differences is $\tilde{D} = 1.7$. After excluding ties there are $n' = 10$ pairs remaining. The negative and positive rank sums are, respectively, $T_- = 2$ and $T_+ = 53$. The mean and standard deviation of the negative or positive rank sums are $\mu_T = 27.5$ and $\sigma_T = 9.811$. This gives Z-score $Z = (T_+ - \mu_T)/\sigma_T = 2.599$. The continuity correction is applied as $Z_{correct} = (T_+ \pm 0.5 - \mu_T)/\sigma_T$. Using the exact sign rank distribution we obtain P-value $= 0.00293$. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. Using the normal approximation gives P-value $= 0.004672$ without the continuity correction, and P-value $= 0.005413$ with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Rank $\|D\|$	Sign
1	8.1	5.6	2.5	7.0	+
2	2.4	-0.9	3.3	10.0	+
3	2.2	-1.0	3.2	9.0	+
4	-1.0	-2.0	1.0	3.5	+
5	0.9	-2.0	2.9	8.0	+
6	2.0	1.8	0.2	1.0	+
7	-0.9	-3.0	2.1	6.0	+
8	-0.7	-2.0	1.3	5.0	+
9	1.1	1.5	-0.4	2.0	-
10	-2.0	-3.0	1.0	3.5	+

Q164 [Answer]: The sample median of the differences is $\tilde{D} = 1.7$. After excluding ties there are $n' = 5$ pairs remaining. The negative and positive rank sums are, respectively, $T_- = 1$ and $T_+ = 14$. The mean and standard deviation of the negative or positive rank sums are $\mu_T = 7.5$ and $\sigma_T = 3.708$. This gives Z-score $Z = (T_+ - \mu_T)/\sigma_T = 1.753$. The continuity correction is applied as $Z_{correct} = (T_+ \pm 0.5 - \mu_T)/\sigma_T$. Using the exact sign rank distribution we obtain P-value $= 0.125$. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$. Using the normal approximation gives P-value $= 0.07962$ without the continuity correction, and P-value $= 0.1056$ with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Rank $\|D\|$	Sign
1	5.5	6.1	-0.6	1.0	-
2	4.5	3.2	1.3	2.0	+
3	5.8	2.9	2.9	4.0	+
4	6.4	3.0	3.4	5.0	+
5	9.9	8.2	1.7	3.0	+

Q165 [Answer]: The sample median of the differences is $\tilde{D} = 0$. After excluding ties there are $n' = 8$ pairs remaining. The negative and positive rank sums are, respectively, $T_{-} = 23$ and $T_{+} = 13$. The mean and standard deviation of the negative or positive rank sums are $\mu_T = 18$ and $\sigma_T = 7.141$. This gives Z-score $Z = (T_{+} - \mu_T)/\sigma_T =$ -0.7. The continuity correction is applied as $Z_{correct} = (T_{+} \pm 0.5 - \mu_T)/\sigma_T$. Using the exact sign rank distribution we obtain P-value = 0.2734. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.01$. Using the normal approximation gives P-value = 0.2419 without the continuity correction, and P-value = 0.2643 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Rank $\|D\|$	Sign
1	2.8	3.2	-0.4	2.0	-
2	5.9	11.6	-5.7	8.0	-
3	2.7	2.7	0.0		0
4	7.0	10.6	-3.6	6.0	-
5	0.9	-2.0	2.9	5.0	+
6	-3.0	-5.0	2.0	4.0	+
7	2.7	2.6	0.1	1.0	+
8	6.6	10.4	-3.8	7.0	-
9	2.7	1.5	1.2	3.0	+

Q166 [Answer]: The sample median of the differences is $\tilde{D} = 1.8$. After excluding ties there are $n' = 6$ pairs remaining. The negative and positive rank sums are, respectively, $T_{-} = 2$ and $T_{+} = 19$. The mean and standard deviation of the negative or positive rank sums are $\mu_T = 10.5$ and $\sigma_T = 4.77$. This gives Z-score $Z = (T_{+} - \mu_T)/\sigma_T = 1.782$. The continuity correction is applied as $Z_{correct} = (T_{+} \pm 0.5 - \mu_T)/\sigma_T$. Using the exact sign rank distribution we obtain P-value = 0.04688. Therefore, reject the null hypothesis at a significance level $\alpha = 0.1$. Using the normal approximation gives P-value = 0.03737 without the continuity correction, and P-value = 0.04675 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Rank $\|D\|$	Sign
1	32.7	30.9	1.8	3.0	+
2	29.1	27.0	2.1	4.0	+
3	29.7	26.7	3.0	6.0	+
4	33.6	33.6	0.0		0
5	30.5	32.3	-1.8	2.0	-
6	25.5	23.2	2.3	5.0	+
7	36.6	35.1	1.5	1.0	+

Q167 [Answer]: The sample median of the differences is $\tilde{D}$ = -0.55. After excluding ties there are $n' = 5$ pairs remaining. The negative and positive rank sums are, respectively, $T_- = 10$ and $T_+ = 5$. The mean and standard deviation of the negative or positive rank sums are $\mu_T = 7.5$ and $\sigma_T = 3.708$. This gives Z-score $Z = (T_+ - \mu_T)/\sigma_T =$ -0.674. The continuity correction is applied as $Z_{correct} = (T_+ \pm 0.5 - \mu_T)/\sigma_T$. Using the exact sign rank distribution we obtain P-value = 0.3125. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$. Using the normal approximation gives P-value = 0.2501 without the continuity correction, and P-value = 0.2948 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Rank $\|D\|$	Sign
1	9.7	9.2	0.5	1.0	+
2	11.2	13.7	-2.5	5.0	-
3	14.6	15.7	-1.1	2.5	-
4	11.0	9.5	1.5	4.0	+
5	11.3	11.3	0.0		0
6	9.8	10.9	-1.1	2.5	-

Q168 [Answer]: The sample median of the differences is $\tilde{D}$ = -1.2. After excluding ties there are $n' = 9$ pairs remaining. The negative and positive rank sums are, respectively, $T_- = 42$ and $T_+ = 3$. The mean and standard deviation of the negative or positive rank sums are $\mu_T = 22.5$ and $\sigma_T = 8.441$. This gives Z-score $Z = (T_+ - \mu_T)/\sigma_T =$ -2.31. The continuity correction is applied as $Z_{correct} = (T_+ \pm 0.5 - \mu_T)/\sigma_T$. Using the exact sign rank distribution we obtain P-value = 0.009766. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. Using the normal approximation gives P-value = 0.01044 without the continuity correction, and P-value = 0.0122 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Rank $\|D\|$	Sign
1	34.4	36.3	-1.9	9.0	-
2	32.8	34.5	-1.7	7.5	-
3	34.3	36.0	-1.7	7.5	-
4	34.4	35.6	-1.2	5.0	-
5	33.6	34.7	-1.1	4.0	-
6	34.7	34.0	0.7	2.0	+
7	34.5	35.9	-1.4	6.0	-
8	31.7	31.3	0.4	1.0	+
9	33.6	34.6	-1.0	3.0	-

Q169 [Answer]: The sample median of the differences is $\tilde{D}$ = -0.35. After excluding ties there are $n' = 10$ pairs remaining. The negative and positive rank sums are, respectively, $T_{-} = 30$ and $T_{+} = 25$. The mean and standard deviation of the negative or positive rank sums are $\mu_T = 27.5$ and $\sigma_T = 9.811$. This gives Z-score $Z = (T_{+} - \mu_T)/\sigma_T =$ -0.255. The continuity correction is applied as $Z_{correct} = (T_{+} \pm 0.5 - \mu_T)/\sigma_T$. Using the exact sign rank distribution we obtain P-value = 0.8457. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$. Using the normal approximation gives P-value = 0.7989 without the continuity correction, and P-value = 0.8385 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Rank $\|D\|$	Sign
1	19.2	19.8	-0.6	3.5	-
2	19.4	19.5	-0.1	1.0	-
3	21.1	18.0	3.1	10.0	+
4	21.0	19.0	2.0	7.0	+
5	20.6	21.4	-0.8	5.0	-
6	21.0	23.8	-2.8	8.0	-
7	24.9	24.4	0.5	2.0	+
8	21.9	24.9	-3.0	9.0	-
9	22.3	21.0	1.3	6.0	+
10	22.7	23.3	-0.6	3.5	-

Q170 [Answer]: The sample median of the differences is $\tilde{D} = 2$. After excluding ties there are $n' = 9$ pairs remaining. The negative and positive rank sums are, respectively, $T_{-} = 13$ and $T_{+} = 32$. The mean and standard deviation of the negative or positive rank sums are $\mu_T = 22.5$ and $\sigma_T = 8.441$. This gives Z-score $Z = (T_{+} - \mu_T)/\sigma_T =$ 1.125. The continuity correction is applied as $Z_{correct} = (T_{+} \pm 0.5 - \mu_T)/\sigma_T$. Using the exact sign rank distribution we obtain P-value = 0.1504. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.01$. Using the normal approximation gives P-value = 0.1302 without the continuity correction, and P-value = 0.1432 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Rank $\|D\|$	Sign
1	0.6	-3.0	3.6	8.0	+
2	0.7	3.6	-2.9	7.0	-
3	1.7	1.5	0.2	1.0	+
4	2.0	-0.4	2.4	4.0	+
5	3.7	6.4	-2.7	6.0	-
6	1.7	-0.3	2.0	2.5	+
7	3.2	0.7	2.5	5.0	+
8	2.1	-4.0	6.1	9.0	+
9	3.4	1.4	2.0	2.5	+

Q171 [Answer]: The sample median of the differences is $\tilde{D} = 0$. After excluding ties there are $n' = 6$ pairs remaining. The negative and positive rank sums are, respectively, $T_{-} = 13.5$ and $T_{+} = 7.5$. The mean and standard deviation of the negative or positive rank sums are $\mu_T = 10.5$ and $\sigma_T = 4.77$. This gives Z-score $Z = (T_{+} - \mu_T)/\sigma_T =$ -0.629. The continuity correction is applied as $Z_{correct} = (T_{+} \pm 0.5 - \mu_T)/\sigma_T$. Using the exact sign rank distribution we obtain P-value = 0.7187. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.1$. Using the normal approximation gives P-value = 0.7353 without the continuity correction, and P-value = 0.7685 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	Sample 1 (X)	Sample 2 (Y)	Difference ($D = X - Y$)	Rank $\|D\|$	Sign
1	4.4	3.1	1.3	4.0	+
2	4.6	6.2	-1.6	6.0	-
3	4.7	6.2	-1.5	5.0	-
4	4.7	4.3	0.4	1.0	+
5	4.8	3.8	1.0	2.5	+
6	5.4	6.4	-1.0	2.5	-
7	4.5	4.5	0.0		0

Q172 [Answer]: The sample medians are $\tilde{X}_1 = 5.6$ and $\tilde{X}_2 = 2.5$. The rank sums for samples 1 and 2 are, respectively, $T_1 = 56$ and $T_2 = 10$. The adjusted rank sum is $W = T_1 - n_1(n_1 + 1)/2 = 28$. The mean and standard deviation of T_1 are $\mu_{T_1} = 42$ and $\sigma_{T_1} = 5.292$. This gives Z-score $Z = (T_1 - \mu_{T_1})/\sigma_{T_1} = 2.646$. The continuity correction is applied as $Z_{correct} = (T_1 \pm 0.5 - \mu_{T_1})/\sigma_{T_1}$. Using the exact rank sum distribution we obtain P-value = 0.00303. Therefore, reject the null hypothesis at a significance level $\alpha = 0.01$. Using the normal approximation gives P-value = 0.004075 without the continuity correction, and P-value = 0.005367 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	1	2	3	4	5	6	7	$\tilde{X}_i$
Sample 1	6.1	6.4	5.2	6.1	5.5	4.3	5.6	5.6
Sample 2	1.2	2.7	2.3	2.9				2.5
Ranks 1	9.5	11.0	6.0	9.5	7.0	5.0	8.0	0.0
Ranks 2	1.0	3.0	2.0	4.0				0.0

Q173 [Answer]: The sample medians are $\tilde{X}_1$ = 3.4 and $\tilde{X}_2$ = -5. The rank sums for samples 1 and 2 are, respectively, $T_1 = 91$ and $T_2 = 45$. The adjusted rank sum is $W = T_1 - n_1(n_1+1)/2 = 63$. The mean and standard deviation of T_1 are $\mu_{T_1} = 59.5$ and $\sigma_{T_1} = 9.447$. This gives Z-score $Z = (T_1 - \mu_{T_1})/\sigma_{T_1} = 3.334$. The continuity correction is applied as $Z_{correct} = (T_1 \pm 0.5 - \mu_{T_1})/\sigma_{T_1}$. Using the exact rank sum distribution we obtain P-value = 0.0001748. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. Using the normal approximation gives P-value = 0.0008551 without the continuity correction, and P-value = 0.001033 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	1	2	3	4	5	6	7	8	9	$\tilde{X}_i$
Sample 1	3.6	3.4	2.2	2.9	3.8	2.5	4.4			3.4
Sample 2	-4.0	-5.0	-5.0	-5.0	-4.0	-5.0	-7.0	-4.0	-5.0	-5.0
Ranks 1	14.0	13.0	10.0	12.0	15.0	11.0	16.0			0.0
Ranks 2	8.0	4.0	4.0	4.0	8.0	4.0	1.0	8.0	4.0	0.0

Q174 [Answer]: The sample medians are $\tilde{X}_1$ = 8.4 and $\tilde{X}_2$ = 17.95. The rank sums for samples 1 and 2 are, respectively, $T_1 = 36$ and $T_2 = 42$. The adjusted rank sum is $W = T_1 - n_1(n_1+1)/2 = 0$. The mean and standard deviation of T_1 are $\mu_{T_1} = 52$ and $\sigma_{T_1} = 5.888$. This gives Z-score $Z = (T_1 - \mu_{T_1})/\sigma_{T_1}$ = -2.72. The continuity correction is applied as $Z_{correct} = (T_1 \pm 0.5 - \mu_{T_1})/\sigma_{T_1}$. Using the exact rank sum distribution we obtain P-value = 0.00404. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. Using the normal approximation gives P-value = 0.006578 without the continuity correction, and P-value = 0.008475 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	1	2	3	4	5	6	7	8	$\tilde{X}_i$
Sample 1	11.3	11.2	6.8	5.6	6.8	8.0	8.8	10.9	8.4
Sample 2	17.9	18.0	17.3	18.6					17.9
Ranks 1	8.0	7.0	2.5	1.0	2.5	4.0	5.0	6.0	0.0
Ranks 2	10.0	11.0	9.0	12.0					0.0

Q175 [Answer]: The sample medians are $\tilde{X}_1$ = 4.9 and $\tilde{X}_2$ = 3.7. The rank sums for samples 1 and 2 are, respectively, $T_1 = 50$ and $T_2 = 28$. The adjusted rank sum is $W = T_1 - n_1(n_1+1)/2 = 35$. The mean and standard deviation of T_1 are $\mu_{T_1} = 32.5$ and

$\sigma_{T_1} = 6.158$. This gives Z-score $Z = (T_1 - \mu_{T_1})/\sigma_{T_1} = 2.842$. The continuity correction is applied as $Z_{correct} = (T_1 \pm 0.5 - \mu_{T_1})/\sigma_{T_1}$. Using the exact rank sum distribution we obtain P-value = 0.002525. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. Using the normal approximation gives P-value = 0.004483 without the continuity correction, and P-value = 0.005766 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	1	2	3	4	5	6	7	$\tilde{X}_i$
Sample 1	4.9	5.0	4.6	4.2	4.9			4.9
Sample 2	3.5	3.2	3.7	4.1	3.9	3.7	2.8	3.7
Ranks 1	10.5	12.0	9.0	8.0	10.5			0.0
Ranks 2	3.0	2.0	4.5	7.0	6.0	4.5	1.0	0.0

Q176 [Answer]: The sample medians are $\tilde{X}_1 = 2.8$ and $\tilde{X}_2 =$ -20. The rank sums for samples 1 and 2 are, respectively, $T_1 = 70$ and $T_2 = 21$. The adjusted rank sum is $W = T_1 - n_1(n_1+1)/2 = 42$. The mean and standard deviation of T_1 are $\mu_{T_1} = 49$ and $\sigma_{T_1} = 7$. This gives Z-score $Z = (T_1 - \mu_{T_1})/\sigma_{T_1} = 3$. The continuity correction is applied as $Z_{correct} = (T_1 \pm 0.5 - \mu_{T_1})/\sigma_{T_1}$. Using the exact rank sum distribution we obtain P-value = 0.001166. Therefore, reject the null hypothesis at a significance level $\alpha = 0.1$. Using the normal approximation gives P-value = 0.0027 without the continuity correction, and P-value = 0.003405 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	1	2	3	4	5	6	7	$\tilde{X}_i$
Sample 1	2.6	2.0	4.6	-1.0	3.8	4.6	2.8	2.8
Sample 2	-10.0	-10.0	-20.0	-20.0	-20.0	-20.0		-20.0
Ranks 1	9.0	8.0	12.5	7.0	11.0	12.5	10.0	0.0
Ranks 2	5.5	5.5	2.5	2.5	2.5	2.5		0.0

Q177 [Answer]: The sample medians are $\tilde{X}_1 =$ -0.185 and $\tilde{X}_2 = 1.7$. The rank sums for samples 1 and 2 are, respectively, $T_1 = 41.5$ and $T_2 = 78.5$. The adjusted rank sum is $W = T_1 - n_1(n_1+1)/2 = 20.5$. The mean and standard deviation of T_1 are $\mu_{T_1} = 48$ and $\sigma_{T_1} = 8.485$. This gives Z-score $Z = (T_1 - \mu_{T_1})/\sigma_{T_1} =$ -0.766. The continuity correction is applied as $Z_{correct} = (T_1 \pm 0.5 - \mu_{T_1})/\sigma_{T_1}$. Using the exact rank sum distribution we obtain P-value = 0.4559. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.01$. Using the normal approximation gives P-value = 0.4437 without the continuity correction, and P-value = 0.4795 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	1	2	3	4	5	6	7	8	9	$\tilde{X}_i$
Sample 1	-3.0	-1.0	-0.1	0.1	-0.3	4.5				-0.2
Sample 2	7.9	7.1	-5.0	1.7	-3.0	6.0	0.2	2.2	-8.0	1.7
Ranks 1	3.5	5.0	7.0	8.0	6.0	12.0				0.0
Ranks 2	15.0	14.0	2.0	10.0	3.5	13.0	9.0	11.0	1.0	0.0

Q178 [Answer]: The sample medians are $\tilde{X}_1 = 7.2$ and $\tilde{X}_2 = 9.45$. The rank sums for samples 1 and 2 are, respectively, $T_1 = 17$ and $T_2 = 49$. The adjusted rank sum is $W = T_1 - n_1(n_1+1)/2 = 2$. The mean and standard deviation of T_1 are $\mu_{T_1} = 30$ and $\sigma_{T_1} = 5.477$. This gives Z-score $Z = (T_1 - \mu_{T_1})/\sigma_{T_1} =$ -2.37. The continuity correction is applied as $Z_{correct} = (T_1 \pm 0.5 - \mu_{T_1})/\sigma_{T_1}$. Using the exact rank sum distribution we obtain P-value = 0.008658. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. Using the normal approximation gives P-value = 0.008811 without the continuity correction, and P-value = 0.01124 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	1	2	3	4	5	6	$\tilde{X}_i$
Sample 1	8.1	6.6	6.4	7.2	8.2		7.2
Sample 2	8.3	11.6	10.7	10.1	7.6	8.8	9.4
Ranks 1	5.0	2.0	1.0	3.0	6.0		0.0
Ranks 2	7.0	11.0	10.0	9.0	4.0	8.0	0.0

Q179 [Answer]: The sample medians are $\tilde{X}_1 = 9.4$ and $\tilde{X}_2 = 8.15$. The rank sums for samples 1 and 2 are, respectively, $T_1 = 37$ and $T_2 = 41$. The adjusted rank sum is $W = T_1 - n_1(n_1+1)/2 = 27$. The mean and standard deviation of T_1 are $\mu_{T_1} = 26$ and $\sigma_{T_1} = 5.888$. This gives Z-score $Z = (T_1 - \mu_{T_1})/\sigma_{T_1} = 1.868$. The continuity correction is applied as $Z_{correct} = (T_1 \pm 0.5 - \mu_{T_1})/\sigma_{T_1}$. Using the exact rank sum distribution we obtain P-value = 0.03636. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. Using the normal approximation gives P-value = 0.03086 without the continuity correction, and P-value = 0.03727 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	1	2	3	4	5	6	7	8	$\tilde{X}_i$
Sample 1	9.7	9.1	10.0	7.9					9.4
Sample 2	8.1	6.8	7.8	8.8	8.2	8.9	8.4	6.9	8.1
Ranks 1	11.0	10.0	12.0	4.0					0.0
Ranks 2	5.0	1.0	3.0	8.0	6.0	9.0	7.0	2.0	0.0

Q180 [Answer]: The sample medians are $\tilde{X}_1 = 23.2$ and $\tilde{X}_2 = 22.2$. The rank sums for samples 1 and 2 are, respectively, $T_1 = 29$ and $T_2 = 37$. The adjusted rank sum is $W = T_1 - n_1(n_1+1)/2 = 19$. The mean and standard deviation of T_1 are $\mu_{T_1} = 24$ and

$\sigma_{T_1} = 5.292$. This gives Z-score $Z = (T_1 - \mu_{T_1})/\sigma_{T_1} = 0.945$. The continuity correction is applied as $Z_{correct} = (T_1 \pm 0.5 - \mu_{T_1})/\sigma_{T_1}$. Using the exact rank sum distribution we obtain P-value = 0.2061. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.05$. Using the normal approximation gives P-value = 0.1724 without the continuity correction, and P-value = 0.1975 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	1	2	3	4	5	6	7	$\tilde{X}_i$
Sample 1	22.8	25.4	23.6	20.6				23.2
Sample 2	23.3	22.2	23.5	18.8	21.4	23.7	19.9	22.2
Ranks 1	6.0	11.0	9.0	3.0				0.0
Ranks 2	7.0	5.0	8.0	1.0	4.0	10.0	2.0	0.0

Q181 [Answer]: The sample medians are $\tilde{X}_1 = 3.6$ and $\tilde{X}_2 = 14$. The rank sums for samples 1 and 2 are, respectively, $T_1 = 45$ and $T_2 = 60$. The adjusted rank sum is $W = T_1 - n_1(n_1 + 1)/2 = 0$. The mean and standard deviation of T_1 are $\mu_{T_1} = 67.5$ and $\sigma_{T_1} = 7.5$. This gives Z-score $Z = (T_1 - \mu_{T_1})/\sigma_{T_1} =$ -3. The continuity correction is applied as $Z_{correct} = (T_1 \pm 0.5 - \mu_{T_1})/\sigma_{T_1}$. Using the exact rank sum distribution we obtain P-value = 0.0004995. Therefore, reject the null hypothesis at a significance level $\alpha = 0.1$. Using the normal approximation gives P-value = 0.00135 without the continuity correction, and P-value = 0.001677 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	1	2	3	4	5	6	7	8	9	$\tilde{X}_i$
Sample 1	-2.0	6.7	1.4	9.4	3.6	5.6	6.1	0.5	0.8	3.6
Sample 2	19.0	12.6	14.0	12.8	18.6					14.0
Ranks 1	1.0	8.0	4.0	9.0	5.0	6.0	7.0	2.0	3.0	0.0
Ranks 2	14.0	10.0	12.0	11.0	13.0					0.0

Q182 [Answer]: The sample medians are $\tilde{X}_1 = 2$ and $\tilde{X}_2 = 1.1$. The rank sums for samples 1 and 2 are, respectively, $T_1 = 85.5$ and $T_2 = 50.5$. The adjusted rank sum is $W = T_1 - n_1(n_1 + 1)/2 = 40.5$. The mean and standard deviation of T_1 are $\mu_{T_1} = 76.5$ and $\sigma_{T_1} = 9.447$. This gives Z-score $Z = (T_1 - \mu_{T_1})/\sigma_{T_1} = 0.953$. The continuity correction is applied as $Z_{correct} = (T_1 \pm 0.5 - \mu_{T_1})/\sigma_{T_1}$. Using the exact rank sum distribution we obtain P-value = 0.2039. Therefore, do not reject the null hypothesis at a significance level $\alpha = 0.01$. Using the normal approximation gives P-value = 0.1704 without the continuity correction, and P-value = 0.1841 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	1	2	3	4	5	6	7	8	9	$\tilde{X}_i$
Sample 1	2.5	-0.8	2.6	3.3	2.4	1.2	-0.7	0.7	2.0	2.0
Sample 2	-1.0	2.6	1.1	3.6	-0.9	1.1	-1.0			1.1
Ranks 1	12.0	4.0	13.5	15.0	11.0	9.0	5.0	6.0	10.0	0.0
Ranks 2	1.5	13.5	7.5	16.0	3.0	7.5	1.5			0.0

Q183 [Answer]: The sample medians are $\tilde{X}_1 = 8.7$ and $\tilde{X}_2 = 6.7$. The rank sums for samples 1 and 2 are, respectively, $T_1 = 74$ and $T_2 = 46$. The adjusted rank sum is $W = T_1 - n_1(n_1+1)/2 = 53$. The mean and standard deviation of T_1 are $\mu_{T_1} = 48$ and $\sigma_{T_1} = 8.485$. This gives Z-score $Z = (T_1 - \mu_{T_1})/\sigma_{T_1} = 3.064$. The continuity correction is applied as $Z_{correct} = (T_1 \pm 0.5 - \mu_{T_1})/\sigma_{T_1}$. Using the exact rank sum distribution we obtain P-value = 0.0003996. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. Using the normal approximation gives P-value = 0.001092 without the continuity correction, and P-value = 0.001327 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	1	2	3	4	5	6	7	8	9	$\tilde{X}_i$
Sample 1	9.6	9.0	8.3	9.3	8.1	8.4				8.7
Sample 2	6.4	8.2	6.7	7.5	7.3	7.8	6.7	6.2	6.7	6.7
Ranks 1	15.0	13.0	11.0	14.0	9.0	12.0				0.0
Ranks 2	2.0	10.0	4.0	7.0	6.0	8.0	4.0	1.0	4.0	0.0

Q184 [Answer]: The sample medians are $\tilde{X}_1 = 18.25$ and $\tilde{X}_2 = 27.15$. The rank sums for samples 1 and 2 are, respectively, $T_1 = 40$ and $T_2 = 38$. The adjusted rank sum is $W = T_1 - n_1(n_1+1)/2 = 4$. The mean and standard deviation of T_1 are $\mu_{T_1} = 52$ and $\sigma_{T_1} = 5.888$. This gives Z-score $Z = (T_1 - \mu_{T_1})/\sigma_{T_1} = -2.04$. The continuity correction is applied as $Z_{correct} = (T_1 \pm 0.5 - \mu_{T_1})/\sigma_{T_1}$. Using the exact rank sum distribution we obtain P-value = 0.04848. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. Using the normal approximation gives P-value = 0.04154 without the continuity correction, and P-value = 0.0508 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	1	2	3	4	5	6	7	8	$\tilde{X}_i$
Sample 1	12.5	22.2	18.4	9.3	25.0	18.1	10.6	21.0	18.2
Sample 2	19.6	32.6	31.2	23.1					27.1
Ranks 1	3.0	8.0	5.0	1.0	10.0	4.0	2.0	7.0	0.0
Ranks 2	6.0	12.0	11.0	9.0					0.0

Q185 [Answer]: The sample medians are $\tilde{X}_1 = 7.1$ and $\tilde{X}_2 = -3$. The rank sums for samples 1 and 2 are, respectively, $T_1 = 51$ and $T_2 = 15$. The adjusted rank sum is $W = T_1 - n_1(n_1+1)/2 = 30$. The mean and standard deviation of T_1 are $\mu_{T_1} = 36$ and

$\sigma_{T_1} = 5.477$. This gives Z-score $Z = (T_1 - \mu_{T_1})/\sigma_{T_1} = 2.739$. The continuity correction is applied as $Z_{correct} = (T_1 \pm 0.5 - \mu_{T_1})/\sigma_{T_1}$. Using the exact rank sum distribution we obtain P-value = 0.002165. Therefore, reject the null hypothesis at a significance level $\alpha = 0.05$. Using the normal approximation gives P-value = 0.003085 without the continuity correction, and P-value = 0.004057 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	1	2	3	4	5	6	$\tilde{X}_i$
Sample 1	8.0	7.3	4.4	3.4	7.7	6.9	7.1
Sample 2	-6.0	-0.8	-3.0	-3.0	-4.0		-3.0
Ranks 1	11.0	9.0	7.0	6.0	10.0	8.0	0.0
Ranks 2	1.0	5.0	3.5	3.5	2.0		0.0

Q186 [Answer]: The sample medians are $\tilde{X}_1 = 5.4$ and $\tilde{X}_2 =$ -3.5. The rank sums for samples 1 and 2 are, respectively, $T_1 = 81$ and $T_2 = 10$. The adjusted rank sum is $W = T_1 - n_1(n_1 + 1)/2 = 36$. The mean and standard deviation of T_1 are $\mu_{T_1} = 63$ and $\sigma_{T_1} = 6.481$. This gives Z-score $Z = (T_1 - \mu_{T_1})/\sigma_{T_1} = 2.777$. The continuity correction is applied as $Z_{correct} = (T_1 \pm 0.5 - \mu_{T_1})/\sigma_{T_1}$. Using the exact rank sum distribution we obtain P-value = 0.002797. Therefore, reject the null hypothesis at a significance level $\alpha = 0.1$. Using the normal approximation gives P-value = 0.005479 without the continuity correction, and P-value = 0.006928 with the continuity correction. Note that the exact method assumes that there are no ties in the ranks. When ties exist, the normal approximation should be used.

	1	2	3	4	5	6	7	8	9	$\tilde{X}_i$
Sample 1	6.1	6.9	5.4	4.0	5.5	5.1	5.1	4.7	5.4	5.4
Sample 2	-2.0	-3.0	-4.0	-6.0						-3.5
Ranks 1	12.0	13.0	9.5	5.0	11.0	7.5	7.5	6.0	9.5	0.0
Ranks 2	4.0	3.0	2.0	1.0						0.0